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For the Waterworks Man

TO mark the meeting of the New England Waterworks Association in Portland next week this issue of the Engineering Record contains more than the usual number of waterworks articles. The aim has been to select subjects of general importance and applicability, rather than the spectacular works with which the average waterworks engineer and superintendent never has to deal. Meter testing, moss removal, new filtration-plant devices, department organization, a traveling laboratory are the subjects discussed. The articles contain many valuable suggestions for the improvement of the service which the waterworks men render the public.

Tribute to an Engineer

ONE cannot read without a thrill the letter from L. F. Heuperman on page 330 of this issue, telling about the recognition which was given C. R. Broughton, engineer for the Southern Pacific Company, on the completion of his work. The incident is most gratifying. Too often the engineer's position is radically reversed between the construction period and the dedicatory ceremony. While the dirt is flying and results are demanded, while difficulties are being met in "putting the work through," the engineer is a most important factor. To him come all hands when trouble is brewing. He must save the day if there are difficulties with labor or materials or if the elements threaten destruction. But when the work is completed he is too often relegated to the background. The financier, the public official, the prominent citizen bask in the limelight and pat each other's backs upon the successful issue of the work. Happily at North Bend such was not the case. First credit was given to the engineer, and those in attendance indicated by their thundering applause that the credit was deserved.

Reconstruction of Europe

IN THE LEADING ARTICLE in this issue W. S. Kies, vice-president of the National City Bank, New York City, and of the American International Corporation, expresses his views regarding American opportunity in the rehabilitation of Europe after the war. His words should be weighed carefully by engineers and contractors who have been considering Europe as a possible field for future activities.

Technical men in active practice are prone to regard such an immense task as the reconstruction in Europe will present as primarily an engineering problem, without giving due consideration to the question of finance. Mr. Kies' position in the banking world entitles his opinions on such subjects to the greatest respect. His viewpoint, of course, is different from that of the engineer. He sees the need for organization, and engineering and constructional skill, but his broad experience leads him further to the conclusion that financing is of first importance in the conduct of work under the conditions that will obtain in Europe. It remains for engineers, contractors and manufacturers of equipment to act upon Mr. Kies' suggestion for the establishment of an American engineering bureau abroad. Such an organization, he points out, would be the first logical step in the securing of foreign business. Certainly no large scale operations can be conducted without a painstaking survey of conditions and the co-operation of construction, manufacturing and financial interests. It may be possible for individual companies to secure small contracts of various sorts without special preparation. In doing so, however, the really big opportunity would be lost. Mr. Kies would plan a construction campaign involving not merely the rebuilding of one industry or one city, but hundreds of industries and hundreds of cities. News reports indicate that plans for such reconstruction work are already under consideration in France. It is imperative, therefore, if the United States is to share in this reconstruction, that steps be taken immediately toward formulating a broad plan.

Exchange of Information

AN exchange of information among engineers engaged in the same field of work is always decidedly helpful in promoting knowledge. Certain kinds of committee work, for example, depend to a large extent upon the co-operation of members of the profession in replying to lists of specific questions sent out in large numbers. Individual engineers, too, frequently give one another the benefit of their experiences through the medium of correspondence. Within certain limits these forms of exchanging information are highly beneficial to all concerned, but the seeker after information may develop into a public nuisance unless he is possessed of a certain consideration for the other fellow. An engineer in a city which has recently completed large-scale investigations of sewerage and sewage treatment informed one of the editors of this journal recently that if he attempted to answer all of the inquiries he received regarding his work he would have practically no time left for anything else. This engineer was recently appointed chairman of a committee of an engineering society which was instructed to collect information by means of a questionnaire. He decided to make his inquiries a model of their kind, framing them so as to call for a minimum of time required for replies. They were printed and space was left on the sheet for the answers. Each question was definite and could be answered merely by a yes or no, by giving a dimension, or by a single brief descriptive sentence. Every time-saving device he could think of was employed. He wrote on each list of questions the name of the engineer to whom it was sent so as to save the latter the trouble of signing his own name. He forwarded with each list a stamped and self-addressed envelope. These are only a few of the time-saving kinks he resorted to. By his foresight in preparing the questionnaire the work of sending in a reply to his queries had been made almost automatic. His efforts were rewarded. A remarkably high percentage of returns were received only a few days after the questions had been mailed, and the information contained in the answers was in a form which could be readily assembled and interpreted. When engineers are seeking information gratis they should keep constantly in mind that their informant should be called upon for the minimum effort in making a reply.

Replies from Engineers

APROPOS of the preceding note the experience of the New York State Bureau of Municipal Information, which collects and disseminates data for city officials, is of interest. This organization reports that it has found that the records of city engineers are more complete and easily obtainable than are those of most other city departments. The bureau recently issued a questionnaire concerning the method of assessing the cost of sidewalks and curbing to all New York State city engineers. In the return mail were received twenty-one replies and within a week all except three in the state had answered. The experience of the bureau in sending a questionnaire to city officials in general leads to the conclusion that replies may be expected from two-thirds within a period of from one to three weeks, depending upon the length of the list of questions. A second request, it is said, elicits replies from about one-third of the remainder. One of the greatest difficulties which the bureau reports in connection with engineering records is that a lack of standard units makes an accurate and intelligent comparison of data well-nigh impossible. This condition has long been realized, but it cannot be emphasized too often. At the present time, however, the American Society of Municipal Improvements has a committee at work in an effort to standardize units of reporting municipal work. This movement deserves the hearty support of engineers throughout the country.

Pure Water and Water Rates

It is a sound principle in waterworks finance that in order to prevent complaints as to the cost of water it is necessary to furnish water of good quality and maintain a satisfactory service. When the water supply is muddy or colored or has a bad smell, or when the pressure fails, or when something or other goes wrong, the consumers ask the question, "Why are we paying so much for water?" It is the consumers' way of expressing dissatisfaction.

The reason for this is that the cost of a public water supply to the ordinary householder is low when compared with what he pays for other services—light, heat, ice, or telephone—and as long as the water supply is satisfactory he finds no fault with the bill. Indeed, he does not object to an increase in his bill if he believes that additional expense is necessary to improve the service or to filter the water. Nine times out of ten when the consumers of a city object to the cost of water, it is not the cost, but the service, which displeases them.

Not long ago there was hostility between the consumers in a Connecticut town and the private company which supplied the water. It was claimed that the rates were too high and the quality of the water too low. The case was taken to the Public Service Commission, which wisely ordered the company to filter the water and to raise, not lower, the rates. This was done, to the satisfaction of both sides. The people got what they really wanted, good water, and the company got what it wanted, adequate receipts.

Several things follow from the adoption of this principle. The first is that no city should refuse to install a needed filtration plant because of the effect on the water rates. Such refusal is sometimes made by city governments for fear that the increase in rates will injure the standing of the political party in power by adding to the financial burden of the rate payer. In this the politicians are wrong. They do not appreciate that people value pure water above all money considerations, and they do not appreciate that adequate filtration of water seldom adds more than 10 per cent to the cost of the water.

Another corollary to the principle is that water rates should not be determined until the cost of good service is known. The city of Cambridge, Mass., has recently changed its rates for water sold by meter from a sliding scale, which varied from 15 cents per 100 cu. ft. for small quantities to 7½ cents for large quantities, to a flat rate of 10 cents per 100 cu. ft.

Some good reasons for this change were given. The bonds were maturing, interest charges decreasing, and a surplus accumulating. It was thought that the citizens should have the benefit of this condition, and it was known that the surplus was looked upon with covetous eyes by some who hoped to apply it to the general expenses of the city and thus relieve the already high tax rate. Another reason, and a valid one, was that it would encourage the use of meters by the small consumers and tend to reduce the water consumption.

On the other hand, the water supply needs filtration, the distribution reservoir needs to have its leakage stopped, and there are other projects which will soon have to be considered. The cost of these is not known with certainty, but the expense will be considerable. Cambridge is within the natural limits of the metropolitan water system, and it is manifest destiny that at some not distant day metropolitan water will be cheaper for Cambridge than its own supply. Yet in the face of these needs, and before the cost is known, the city so modifies its rates as to make a material reduction in the receipts. It is another instance of considering rates before service, and whatever may be said in favor of substituting a flat rate for a sliding scale, it is a curious case of putting the cart before the horse.

In comparing low rates and the cost of filtration it should be noted also that while low rates tend to attract manufacturers, it is the quality of the water which is considered by persons seeking desirable homes. In these days of city planning, this matter deserves consideration. Looked at from any angle it seems obvious that pure water pays, and that where pure water is furnished the rate question becomes secondary.

Some Aspects of the Railroad Wage Controversy

"THE WORLD is at a crisis just now, and our statesmen do not know this fact; great masses of radical groups are working within our boundaries for a weaker government; only an obsession of crass ignorance can assure us that our relative comfort will last; we cannot get together enough men to catch a border bandit; we have dangerous enemies everywhere; yet our statesmen are interested in fences, pork, the baseball score, poliomyelitis, and sharks on the Jersey coast. Our leaders do not think; they do not know enough to think; they have lost the capacity of appreciating an abstract argument. We talk of the English muddling along; we muddle and stand still."

These words of Dr. Austin O'Malley, a New York physician of keen mind and trenchant pen, would have been read by most Americans with much doubting when they were written only three weeks ago. But how great the change in three weeks! In that time we have seen the Congress of the United States pass, under duress, a law favoring four-tenths of one per cent of our people at the expense of all the other ninety-nine and six-tenths. The popular theory is that the members of Congress lacked the courage of their convictions. There have been happenings in our national life in the last two years that would give color to that explanation, but men who thought clearly on the fundamentals of our government and on the industrial history of this country and of Europe would not have abandoned principle and shirked a fight. The fundamental weakness was clarity of thinking. The yielding to party dictation, to supposed necessity, to the demands of wielders of a compact group of votes, flowed naturally from the muddling of thought.

Is the Stream Deep?

The newspapers of the country quite generally see but the superficial side of the recent conflict. They devote their editorial columns to raillery at the cowardice of Congress or to justification of its course. Most of them discuss the probability of the early revival of the dispute, deplore the methods used by the brotherhoods and contemplate with anxiety the likelihood of the other railroad employees going to Congress with wage-increase demands. The thought is on the public facts of the controversy and its immediate consequences. The careful observer probes beneath the surface. He asks whether as incidents in Congressional history the controversy and its method of settlement have little or much significance; whether as events in the chronicles of American labor they carry any special message to our industrial leaders.

Regulation of Wages

As an event in our legislative history the outstanding feature for the economist is not that Congress for the first time has been openly and brazenly forced to pass class-favoring legislation, even though that fact mark a distinct epoch in the decadence of American statesmanship. The outstanding feature is that the Congress of the United States has assumed the right to fix wages. Unconsciously and under duress it has carried to a logical conclusion the policy of regulating public-utility corporations. Hitherto it has not seen, or has been unwilling to admit, its responsibility in the matter of forced utility expenditures. It limited income some years ago by controlling rates. Then the public stepped in and insisted on arbitration of wage disputes. Congress, too, reflecting the popular demand, became a party to the arbitration program by establishing the federal board of mediation and conciliation. Now it has taken the final step—the step that carries out the logic of the regulation theory. Public-utility regulation was undertaken in order to protect a dependent public from the high-handedness of utility owners. It has been equally apparent for years that the public could suffer from the high-handedness of employees, yet no move was made, other than to establish a powerless board of mediation, to protect the public. If our leaders had thought—had thought clearly—the needed legislation would have been passed long since. There has been ample warning. Three years ago the situation was so acute that an amendment (the Newlands bill) to the Erdman act was hastily passed to avert a strike of the railway firemen. Even a few months back there was time to remedy the neglect. The national chamber of commerce recommended then that wage regulation be made part of the duty of the Interstate Commerce Commission. Congress did not see fit to act. The measure passed in haste and under pressure is entirely inadequate. It does, however, close up the gap in our regulation practice.

Industrial Slavery

The President in asking Congress for legislation recommended a law that would prevent strikes and lockouts during the pendency of an investigation. Discussing this recommendation before the Senate committee on interstate commerce, the brotherhoods' representatives declared that it would be industrial slavery to force men to work against their will. That position indicates an utter failure to understand the rights of the public in utility operation. Compulsory service would be industrial slavery if applied without exception to private industries whose operation has only a remote effect on the welfare of the whole people. This is precisely the theory of the limitation of the interstate commerce laws and of the utility-regulating acts of the states—that the management of private corporations is almost wholly a private affair, but that the conduct of the public-utility corporation, charged as it is with a public interest, is a matter for government supervision. The government's function of conserving the interests of the whole people would justify it in forcing public-utility servants to work pending an investigation. To characterize service under these conditions as "industrial slavery," merely stamps the brotherhood chief using the term as unfit to represent his side in the triple-interest controversy. The rights of the public must be respected.

Abuse of Power Is Loss of Power

Apropos of the last comment, the brotherhood leaders elected the very course most certain to bring about the enactment of stringent supervisory laws. The country has seen and felt their power, and as a result that power will be shorn from them. The reaction has already come. The brotherhoods have been unmercifully lashed by the press. There is a demand for measures that will prevent a repetition of the legislative "hold-up." Undoubtedly the Interstate Commerce Commission will be given authority over wages, while the men will be restrained from striking pending the investigation of disputes. The debate in the Senate and the hearings before the senatorial committee indicate that without the shadow of a doubt. The abuse of power inevitably leads to its loss.

The Social Significance

From the social aspect the demand of the brotherhoods is not an isolated event; nor is it merely an incident in the struggle of the railroad employees for higher compensation. It holds an important place in the development of the labor movement. It is a warning of what is coming, unless we rightly appraise the gravity of the situation and, as a people, adopt a comprehensive solution of the problem.

He is blind who does not see that labor has made remarkable strides in recent years toward getting that "proper share" of the product of its labor for which its leaders have been fighting. The evidences are many. Taking a leaf from the book of capital, labor has entered the political arena. It has not forgotten the things that Congress "put across" for the insiders in the days when the Senate and House were trust and railroad controlled. And so labor has had itself exempted from the Sherman act, and has had efficiency studies ruled out of government establishments. Of commendable measures, it has had the workmen's compensation acts, child and women's labor laws passed. Special legislation enforces precautions where occupational diseases threaten. Hours are shorter, wages higher, working conditions better, and still labor is unsatisfied. Its clamors are louder than ever. Its victories have given it power and it is constantly forcing still further concessions.

And when shall be the end? The Engineering Record, without hesitation, answers, only when the workman has full confidence that he is getting all that the industry can afford to pay him. This confidence cannot come from a vote of the board of directors. It cannot be developed overnight. It is of slow growth, born of fair dealing, of an interest in the worker's welfare, of a plan by which the workers, each according to his performance, get a full reward for their industry. There are companies that have won this confidence, that laugh when others tremble at the prospect of strikes, that earn constantly increasing profits because a basically sound plan stimulates the men to give of their best, confident that their proper share will find its way into their pay envelopes and not into the pockets of the owners.

But where there is one corporation in that enviable position there are a hundred that try to get the most work for the least pay, that allow the judgment and tyranny of foremen, rather than a square-deal company policy, to determine the character of their labor force, that care nothing for the welfare of the men so long as they (the corporations) get production. Backward employers do as little for their men as they dare; they are forced—by the law or by their employees—into every improvement.

The farsighted employers, with a touch of human kindness that, happily, pays dividends, anticipate both the law and their employees' demands. Sanitary and working conditions, hours, wages, the future of their men, have all had consideration, and each has been determined on a basis of justice to the men and in a fashion to bring out the best that is in them. Some companies, confident that there can be no industrial peace unless the workers are partners in the business, allow the men to choose from their fellows one or more directors of the company. The employees thus have means of learning exactly the financial standing of the company and its ability to grant higher compensation, shorter hours or any other concession which may be under discussion.

But here again new methods cannot be installed by fiat. An industry is an organism; it is reformed only by gradual process. One fundamental of the transformation is that each step shall conduce to higher efficiency. An ill-considered profit-sharing scheme that does not result in better or more work is doomed to failure. A shortening of hours that has no compensating advantage may lead to the destruction of the business through inability to meet competition. And so through the whole gamut of possible industrial improvements.

Often it is hard to see whence the new profits will come. A pension plan, for example, shows little or no immediate returns. But here the manager with vision is a necessity. In other words, the managements as well as the men need to be remade if the labor question is to be solved.

When employment is on a proper basis the whole character of an industry changes. One feels it in going through the Procter & Gamble soap works, the National Cash Register plant and many smaller industries where the paternal attitude of the founders still persists. Employment in such plants is an honor, is sought for and is not lightly thrown away. The men know that they are not mere tools, to be used and scrapped as the management wills. They know that the interest of the management is not in holding down the payroll, but in increasing it whenever an employee's work has added to the success and profits of the company.

Until at least a majority of our industries are on this basis, the labor problem will be with us. May we not have a right to expect that the clash of last week will awaken our industrial leaders to a realization of the seriousness of our labor situation, and to a determination to take the steps—no matter how abhorrent to the ideas of the military, one-man-power management—to put our industries on the sure basis of justice and a regard for the feelings and aspirations of the workers?

The Engineer's Opportunity

And if the future industrial peace of this country depends on a new relation between employer and employee, how necessary is it for the engineer to learn the fundamentals of that relation! Industry is his creation. It moves and grows through the laws he has formulated, the processes he has developed, the tools he has built. On an ever-increasing scale the direction of these enterprises lies in his hands. Miss Frances A. Kellor, in her article on the "Engineer and the New Nationalism" (Engineering Record, July 4, 1916), predicted for him the pivotal position in the America of the future. Dr. Frank Crane, the writer of syndicated editorials which appear in newspapers throughout the country, says that "the time will come when the President of the United States will be chosen as the man who has the greatest talent and skill in organizing public works. There will be no more politics in his selection than there is now in choosing the master mechanic of a railway or factory." When others see this future for him, shall the engineer pitch his ambitions lower? Shall he by lack of a sound and broad preparation fail to take the position which others would gladly accord him, and feel he must inevitably hold? If our statesmen can be rightfully accused of "being unable to think," shall the engineer lay himself open to the same charge?

Rehabilitation of Europe Offers Opportunity If American Interests Co-operate—W. S. Kies

Vice-President of National City Bank of New York City and the American International Corporation, in Engineering Record Interview, Discusses Relation of Engineering Construction, Manufacturing and Finance

By ROBERT K. TOMLIN, JR.
Managing Editor of the Engineering Record

IN the rehabilitation of Europe after the war engineering will face the most colossal task in its history. From ruins which scar the face of an entire continent must spring new industries and new cities —not singly but in quantities of hundreds and thousands. Any attempt to state in definite terms the amount of work to be done would lead into the realm of mere guesswork; but certain it is that a declaration of peace will herald the dawn of a reconstruction era such as the world has never before witnessed. Coupled with the demand for vast supplies of machinery, structural steel, cement and building materials of all kinds will come a call for engineering and constructional skill of the highest order. Will American interests be a factor in this work of the physical resurrection of nations and, if so, how can they best equip themselves to render adequate service? These are the questions which William S. Kies, vice-president of the National City Bank of New York City and of the American International Corporation, answered for the Engineering Record in an interview at his office in New York City last week.

SOUND FINANCING ESSENTIAL

"In the rebuilding of Europe," said Mr. Kies, "the opportunity for American contractors, engineers and manufacturers will be what they make it. It will depend primarily upon their ability to develop a close-knit organization for the solution of a great economic problem. If they fail to keep this fact in mind and content themselves merely with a scramble for little contracts here and there the big chance will be lost. What American contractors, engineers and manufacturers must realize, at the outset, is that the task of restoring European industries and cities is not one solely of design and construction on an immense scale. Of course these are essential elements in the problem, but the vital factor is sound financing. It is certain that any work of reconstruction undertaken by American interests must be carried through largely on credit. Payment may take the form of foreign bonds or other securities. Thus it would be folly for any concern to consider work in Europe without a thorough appreciation of the extreme improbability of cash payments. No matter how valuable American machinery, construction methods and engineering skill would be, they will count for little without the backing of American capital.

FOREIGN INVESTMENT

"This country's participation in the rebuilding of Europe can be made effective on a large scale only if groups of American engineering, construction and supply interests form some sort of co-operative association under the auspices of responsible banking and investment-manager corporations. With the right kind of organization developed I believe that the reconstruction work in Europe will warrant the solid support of American investors. We must not forget the axiom: "Trade follows foreign investment." When a nation invests systematically in large volume in foreign countries the capital invariably goes out largely in the form of machinery, construction materials, tools and general supplies for construction forces. Afterward the enterprises upon which these materials are used continue to buy supplies for maintenance, repairs and renewals. This business induces other importations from the lending countries. Even such foreign investments as loans to governments or to municipalities are recognized as being of immense assistance in the building up of foreign commerce. It has been a part of the program of the National City Bank of New York to assist in the organization of facilities for foreign investments on a safe and effective basis."

AMERICAN INTERNATIONAL CORPORATION WILL CO-OPERATE BY SUPPLYING CAPITAL

The American International Corporation has been studying the possibilities of American participation in European reconstruction and, according to Mr. Kies, stands ready to lend its financial backing to well-considered projects. In fact this is the very object for which it was created. "There has been some popular misconception regarding the work of the American International Corporation," said Mr. Kies. "The main purpose of this organization is to co-operate with existing engineering and contracting concerns. Under special conditions, however, the necessity may arise for the American International Corporation to organize subsidiary construction companies, but its functions are chiefly supervisory. It has on its staff engineers qualified to examine and report upon any construction program submitted to it. In other words, the corporation was established as an agency through which individual American investors could employ their funds in a way to make them most effective as part of a systematic American development of foreign investments, interlocking closely with American export expansion and the extension of direct American banking representation; but the corporation does not intend to waste time on schemes which have not been studied carefully enough to indicate their practicability."

ADVOCATES AMERICAN ENGINEERING BUREAU ABROAD

It was suggested to Mr. Kies that even if groups of American interests could pool their resources in a co-operative association such as he mentioned they would still be a long way from actually securing foreign work. "First-hand knowledge of local requirements, in France or Belgium for example, would be necessary," replied Mr. Kies, "before plans for any comprehensive construction program could be financed. I think it is time now for American firms interested in this work to get together and establish in Europe an engineering bureau. Its personnel should be recruited from only the highest grade of men, representing the best brains in the engineering, construction and manufacturing fields. Such a bureau could at once begin a study of the problem of reconstruction on a big scale and formulate working plans for the restoration of entire cities or even groups of cities.

WORK WILL BE ORGANIZED

"We must recognize the probability that the early stages of the reconstruction of industry in Europe may be in accordance with some big organized plan under government auspices. The success with which both the Allies and the Teutonic Powers have placed national business activities on a controlled basis—mobilized them—will make sure the national organization of rehabilitation. Nevertheless, we may be sure of the fact that Europe has obtained too clear a view of the fundamentals of industry to stop anywhere short of the quickest, most effective restoration, even at a measure of national expense. Surveys of destruction in France and Belgium, already in progress under national auspices, show that important plans are now in process of formation. If, as a result of the work of an American engineering bureau abroad such as I have suggested, we can show Europe that America is ready with an absolutely certain supply of materials and machinery, an absolutely certain supply of capital, and an organization which can be depended upon for first-class, speedy construction on an enormous scale, the prospects of American participation in the restoration work in Europe will be particularly bright. In other words, if Europe knows that we can be depended upon to do a large amount of reconstruction cheaper than she can do it for herself, Europe will prefer to begin at once getting her labor forces back into the permanent alignment of normal productivity and give us the opportunity of using our surplus capacity in doing as much as we can of this rebuilding."

SIGNS OF ACTIVITY

As indicating the need for the immediate organization of American resources, if any large European contracts are to be secured, Mr. Kies called attention to the fact that press reports, a week or so ago, stated that France had made preparations for the reconstruction of about 3000 towns and villages, destroyed or seriously damaged by the German invasion. Another significant news item mentioned the fact that an exposition is now being held at which great building and contracting corporations of France have presented models of new towns and villages which they will undertake to erect in a given number of days for a fixed sum. A certain quantity of quick construction work will probably be needed, according to this report, even in towns only partly destroyed, as the refugees are said to be anxious to return to the sites of their homes at the earliest possible moment. In the realization of this hope, according to Mr. Kies, the extensive use of American construction plant, capable of a maximum output of finished work with a minimum input of labor, should have an important influence. Even with the comparatively high cost of common labor which obtains in the United States American contractors, it is believed, are able to do work at lower prices than could be attained with cheaper labor in foreign countries. Modernized, highly developed construction plant and methods are held responsible, in large measure, for such results.

Vice-President of National City Bank of New York and American International Corporation, Who Sees in Europe's Rehabilitation an Opportunity for United States Interests

WILLIAM S. KIES

Another indication of approaching activity in foreign rebuilding is the sailing to France, last month, of an American industrial commission organized by the American Manufacturers' Export Association. On this commission prominent contractors and engineers as well as bankers and manufacturers are represented. Another straw in the wind is the recent decision by the American International Corporation to send investigators upon a tour of Russia and to establish a permanent office in Russia.

In the course of the interview, mention also was made of a conference held in Chicago Aug. 21, at which were present representatives of the federal government and of the lumber industry. The object of the meeting was to inquire into the possibilities of the export market. At this meeting it was stated that the Southern Pine Association had a representative in Paris investigating the possibilities of distributing large quantities of timber for reconstruction work in France.

"The immensity of the task confronting the European nations," continued Mr. Kies, "forces upon us an entirely new conception of a working organization for the rebuilding. It is safe to assume that when the armies are disbanded the men from the ranks will immediately be put to work on reconstructing towns and the industries in them. I believe that no provision for the importation of labor from the United States, at least, need be considered. What we would be called upon to supply, in the event of securing a large foreign reconstruction contract, would be an organization more or less supervisory in character, made up of office and field engineers, construction superintendents, etc., adequately financed with American capital, and supplied with the necessary high-speed construction plant of American design.

"I have already mentioned the desirability of establishing an American engineering bureau abroad. This organization should concern itself not merely with preliminary surveys, estimates and designs but should be, in addition, a business-getting agency. The remarkable speed records made by American contractors in the construction of big additions to munitions plants in this country would serve as arguments for swinging work our way. The American manner of mixing and placing concrete in huge quantities and in an incredibly short time, for example, justifies a very careful consideration by European commissions intrusted with the work of reconstruction. The same may be said of our accomplishments in the fabrication and erection of steel structures—buildings and bridges. There is no doubt about our ability to carry on construction work on a large scale and in a minimum time, provided we organize for it and make the necessary arrangements as to its financing."

The first reconstruction to be undertaken abroad, Mr. Kies believes, will undoubtedly be in France and Belgium. Our primary efforts, he thinks, should be directed toward these nations. Next will come Russia—an industrial giant, asleep. Her awakening will signalize an unprecedented opportunity for American enterprise.

Closely linked with matters of engineering and construction abroad is the problem of using, to best advantage, the manufacturing facilities in the United States that have been acquired and paid for out of extraordinary profits during the last year and a half of enormously remunerative war business. "The nation's industries," Mr. Kies pointed out, "are now confronted with the problem of finding a way to use this splendid manufacturing equipment for all it is worth without over-production and, if possible, without 'scrapping' the plant and machinery acquired for temporary use but fully paid for and available if some new use can be found for it. The superabundance of productive facilities necessitates a broadening of our markets. With the right kind of co-operative effort between labor, capital and our government it will be an impossible undertaking for America to make a foreign market big enough to absorb every dollar's worth of our manufacturing output. If the manufacturing and investment public will rise to the opportunity we cannot only draw a permanently increased income from what we gained so cheaply, but we can push the national productive ability to a still higher level.

New Law Needed

"We need a new law," Mr. Kies concluded, "permitting freedom of combination of concerns in foreign trade. If we get it, our national industries will be able to make effective, to a remarkable degree, machinery we already have for co-ordinating on a very large scale the right kind of manufacturing and construction enterprise. With such a law we would be able to carry out in complete detail any contracts for furnishing fully equipped factory plants or even factory towns and at the same time finance the enterprise over a term of years."

$12,000,000 Invested During Past Six Months in Manufacturing Industries

A report recently compiled by the industrial commissioner of the Los Angeles Chamber of Commerce states that the number of factories constructed or in course of construction in territory tributary to Los Angeles for the first half of 1916 exceeds the total for the entire year of 1915. Up to July 1, according to the report, there had been thirty-seven important factories under construction, contracted for, or occupied since January 1. The cash expenditure for the first six months of this year is given as $12,063,000.

Notched Steel Brackets Aid Placing of Hoop Reinforcement for Concrete Reservoir

Duluth's 5,000,000-Gallon Circular Basin Concreted During Freezing Weather—Costs of Construction Are Given

By E. W. KELLY
Engineer, Water and Light Department, Duluth, Minn.

FLAT, notched steel-plate brackets, riveted to vertical 3-in. channels, spaced 7½ ft. on centers, demonstrated their value as supports of the hoop reinforcement used in the construction of the 5,240,000-gal. circular concrete reservoir which serves as a distributing basin for the second pressure zone of the water-supply system of Duluth, Minn. The reinforcing bars were furnished in lengths of about 66 ft. It was found unnecessary to curve them before placing, as the rigidly held notched brackets and clamped laps held them to the exact circle desired. Because of the narrow clearance between the steel and the outside form, the latter was carried up in advance of the steel, and the channels strongly braced thereto at intervals, to enable them to support the great weight of hoop steel. The "spring" of the bars against the notches of the brackets held them so tightly in place that wiring was unnecessary. The bulk of the concrete for this structure was placed during freezing weather.

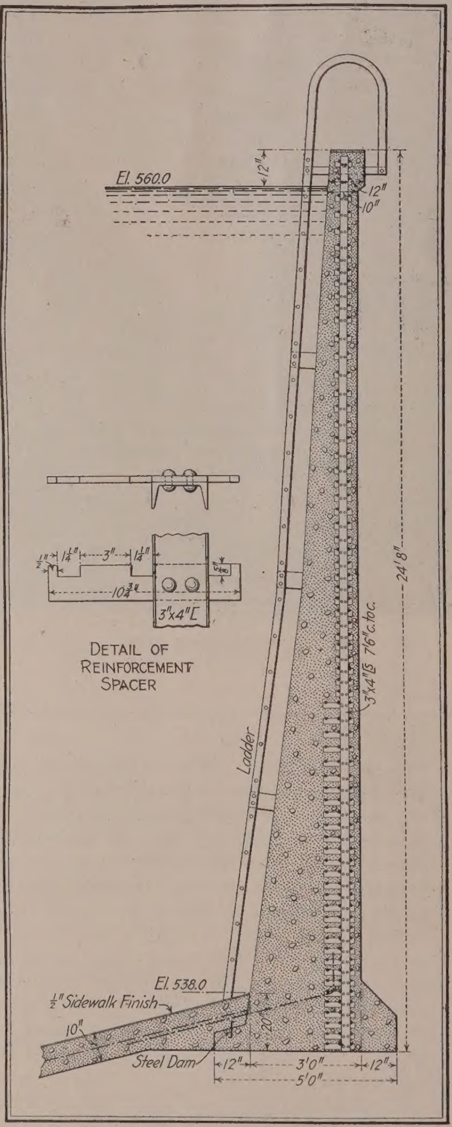
Choice of Site

The choice of a site was narrowed by the size and location of the district to be supplied, which is on the slope of the rocky ridge upon which the city is built; by the desired elevation, which was between El. 550 and 570 above the lake; and by the nature of the soil between these contours. A level site free from rock was not available in the neighborhood indicated by the first two considerations, but a site was available which was not unreasonably rough, and which contained a comparatively small amount of ledge. This site was selected for a reservoir some years ago. Two 12-in. mains were laid thereto, and wooden tanks of a combined capacity of 360,000 gal. were erected upon it for temporary service at that time. The presence of these mains at this point and the large expense of laying similar mains to any other available place were deciding factors in the final selection of this site when, in the spring of 1913, the building of the reservoir was definitely decided upon.

The soil on this property consists of gravel of various degrees of coarseness, loam and hardpan, lying in the irregular layers and masses characteristic of glacial deposits, the gravel being in greater quantity than the other two soils. The presence of several layers or streaks of nearly pure coarse gravel, which would have made watertightness difficult to secure, and the position of the reservoir about 500 ft. higher than the "congested value" district and on the slope directly above it, decided the writer against the earth-embankment type of reservoir, and the circular reinforced-concrete reservoir was therefore selected. The reservoir is built on the rather steep slope of the ridge. This necessitated an unusually large amount of excavation for a reservoir of this size, and it appeared best for only the upper 10 ft. of wall to be above ground, the uphill portion of the reservoir being embedded in the slope and the excavated material forming an embankment on the down-hill side. The elevation selected left the wall footings above the ground surface at some points, while the highest ground within the limits of the structure proper was of the same height as the top of the wall.

Design Assumptions

To keep fluctuations in pressure within what were considered reasonable limits a total available depth of 27 ft. was selected. This fixed the diameter for the desired capacity of about 5,000,000 gal. at about 185 ft. On account of the large diameter it was felt that a unit stress in steel greater than about 12,000 lb. was not permissible. Because of probable inequalities in the pressure exerted by the backfilled earth no deduction from hoop tension was made for external earth pressure, this being regarded simply as an added element of safety. Steel sufficient to take the entire hoop tension at 12,000 lb. per square inch was therefore provided for.



HOOP REINFORCEMENT FOR RESERVOIR WALL WAS SUPPORTED BY NOTCHED STEEL PLATE BRACKETS RIVETED TO VERTICAL CHANNELS

The completed plans were submitted to Dean F. E. Turneaure, as consulting engineer. By his advice the bottom half of the wall was thickened so as not to exceed a unit stress of 240 lb. per square inch in the concrete, assuming steel and concrete both to take tension and in the ratio of 10 to 1. The reinforcement of connections between wall and floor also was increased. At the instance of D. A. Reed, manager of the Duluth waterworks, the allowed unit stress in steel for the upper portion of the wall was progressively reduced toward the top, beginning at a point 11 ft. below the overflow. This was adopted as a precaution against possible ice pressure.

In final form the wall section of the reservoir is shown in the accompanying drawing. Hoop reinforcement is supported on flat notched steel plate brackets riveted to vertical 3-in. channels which are spaced on about 7½-ft. centers. The floor is reinforced with ½-in. square bars, laid at right angles on 1-ft. centers both ways. The margin next the walls is further strengthened by four concentric rings of similar bars on 1-ft. centers. The wall and floor are tied together with ¾-in. square bars 7 ft. long on 2-ft. centers. One-half of the length of these ties is embedded in the floor, the end in the wall being turned upward as shown. A steel ladder was provided for, to give access to the interior of the reservoir.

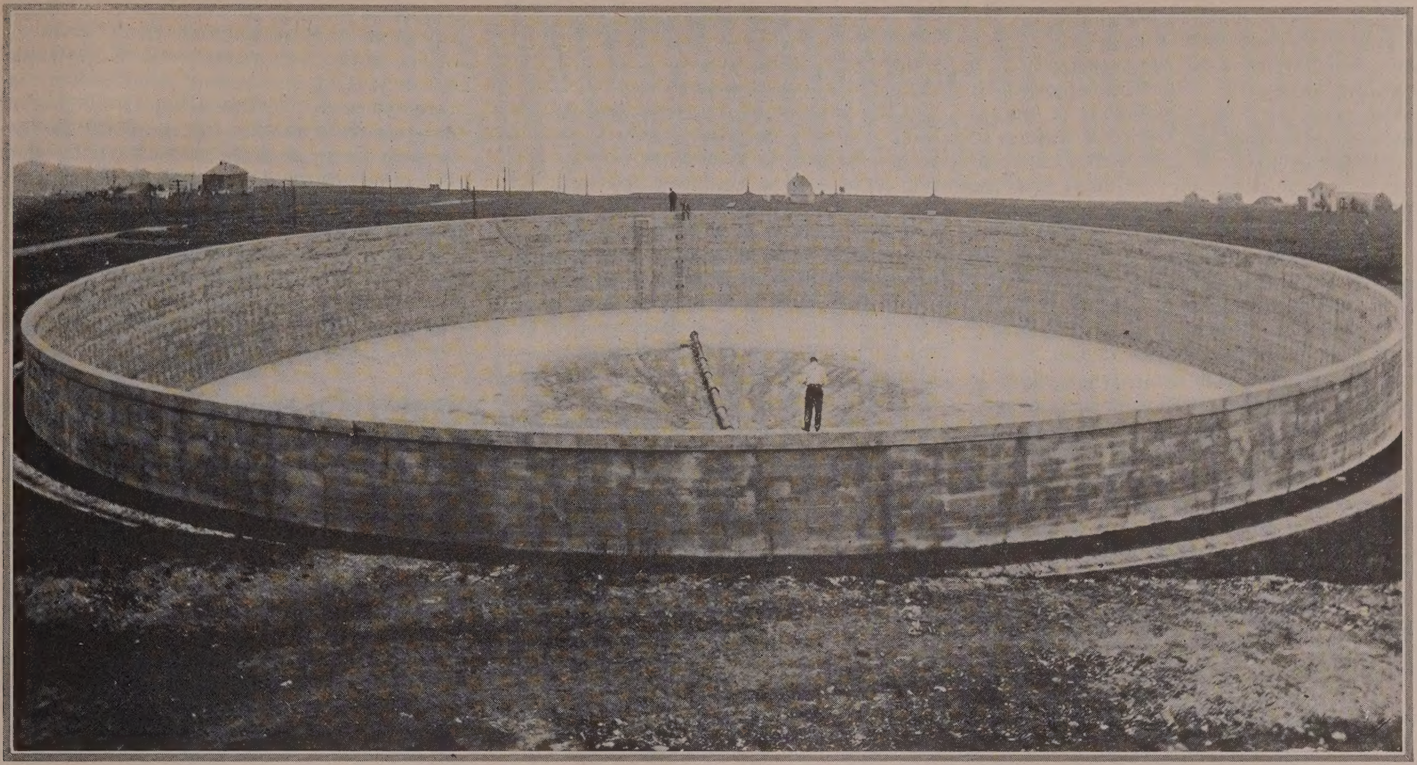
Materials

Sand for concrete making consisted of a mixture of coarse lake sand, pit sand and rock screenings proportioned to meet the following requirements: Passing ¼-in. mesh, 100 per cent; passing No. 20 screen, not less than 65 nor more than 85 per cent; passing No. 100 screen, not over 5 per cent. Coarse aggregate consisted of crusher-run traprock from the excavation. That for the floor and wall was screened to pass a 1-in. ring and be retained on a ¼-in. mesh. For non-waterproof concrete larger aggregate was permitted. For walls and floor a 1:2:3½ mix was specified, but the contractor, wishing to take a little more precaution to insure watertightness, used a 1:2:3 mix. At points where filling was required to bring the ground surface to grade a 1:3:6 concrete was used as filling, and a similar quality concrete was used to fill around pipes under the reservoir floor. The specifications provided that the contractor should waterproof walls if, after construction, leakage should occur or damp spots appear on the exterior of walls.

Construction

Earth was excavated by means of wheeled scrapers. Most of the soil was loosened by plowing, but portions, resembling alluvial silt, required no loosening, while some bodies of hardpan and cemented gravel necessitated blasting. Ledge was encountered over about one-fourth of the floor area. This was a seamy red "trap" that broke in small cuboidal pieces excellent for crushing. Rock was excavated 1 ft. below subgrade and backfilled to grade with material from the remainder of the excavation, well compacted.

All wall reinforcement was placed before concreting was begun. A substantial hub was driven to exact grade for each vertical channel. The channels were secured and braced on these, accurately centered, and



DULUTH CONCRETE RESERVOIR HAS A CAPACITY OF OVER 5,000,000 GALLONS, A DIAMETER OF 185 FEET AND A DEPTH OF ABOUT 24 FEET

exactly vertical. To insure that steel and forms were placed on the exact circle required, a temporary but rigid tower was erected over the center hub of reservoir and a steel tape swung from exact center at various levels as required. The hoop reinforcement was then placed in position in the notches of brackets. The bars were lapped 30 diameters and secured with three Crosby wire rope clamps at each joint, all joints being carefully staggered.

The forms consisted of 1-in. shiplap sheathing on 4 x 4-in. studding wired through the walls. The outside form was completed to the top before commencing concreting, while the inner sheathing was carried up 2 or 3 ft. in advance of the concrete.

CONCRETING IN FREEZING WEATHER

An ample supply of rock taken from the excavation was crushed, screened and stockpiled on the high ground above the reservoir, and about one day's supply of pit and lake sand and of cement were provided before concreting commenced. While concreting was in progress, cement and sand were hauled from the pier by teams and a 5-ton Kissel truck. The latter gave particularly valuable service. The difficulty of transportation will be appreciated upon mention of the fact that the horizontal distance of about 1 mile from the pier involves a rise of 560 ft.

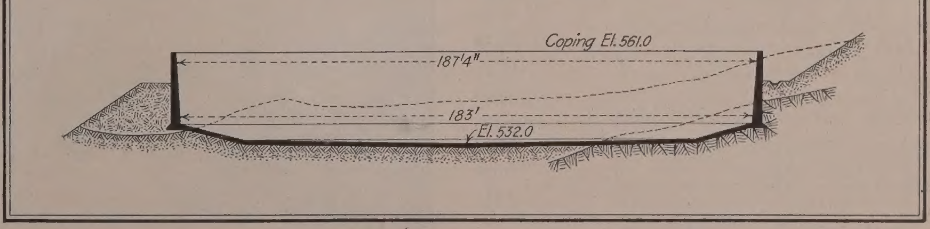
Mixing was by a ½-yd. gasoline-engine-driven Smith mixer, with side loader. A similar but smaller machine was set up alongside this as a reserve. Water was supplied by a small steam pump drawing from wooden tanks previously mentioned. As the temperature was below freezing nearly throughout the job, it was necessary to heat the sand and water. Steam for this purpose was supplied from a 40-hp. boiler near the stock pile to the water tank on the mixer by steam pipe and perforated points attached to steam hose to the sand piles. By this means a temperature of about 90 deg. Fahr. was obtained in the batches as they left the mixer. No trouble from freezing or slow setting was encountered, except as hereafter noted.

Distribution of concrete was accomplished by hopper-bottom cars propelled by two men each on a circular track at the top of the forms. This track was built independent of the forms so as to avoid vibration of the latter. The cars were dumped into hopper-top telescoping steel spouts, four of which were provided, two being in use and the other two in process of being shifted at all times. Cars made a complete circuit of the reservoir at each trip.

Concreting was continued night and day after commencement, in the attempt to produce a true monolith, but this intention was frustrated by weather conditions. The tail end of the terrific gale of Nov. 6, 1913, which caused extensive disasters on the lower Great Lakes, struck this locality when the wall had been brought up to about 10 ft. from the top of the coping. The wind was of such strength as to tear off the runway boards which were nailed to the ties of the track, and it was, of course, humanly impossible to continue. A dam of 23-gage galvanized steel, 8 in. in width, in 6-ft. lengths, had been provided for this contingency, and this was embedded for half its width in the green concrete when work had to be discontinued. Before resuming concreting, the surface of the joint was scrubbed with wire brushes and water under pressure until the aggregate was well exposed. The surface was wetted and covered with creamy grout well scrubbed in, just in advance of new concrete.

While pouring the last round at the top a sudden drop of temperature to well below zero, accompanied by a high wind, started freezing the top of the concrete as it was deposited, and thus again interrupted the work. This also occurred in the early evening. The next morning the top concrete appeared to be frozen to some extent. Hot manure was placed about it, being secured to the sides of the form by strips nailed outside the studding. Under this treatment the frozen concrete quickly thawed and set, and the following day the final pouring was done. It was felt that Providence should not be further tempted by trying to construct the floor, and concreting was therefore discontinued. An opportune thaw made possible the stripping of forms and construction of most of the embankment at this time. The inner toe of wall was also protected from possible heaving by frost by banking with manure.

Work was recommenced in the following June, after the ground had dried and well compacted after the frozen ground had thawed. The wires, extending through the wall, which had secured the form studding, were cut off at least 2 in. below the surface, and the cavities so left were plastered carefully with 1:2 mortar. All reinforcing was placed and wired as the first step in constructing the floor.



THE RESERVOIR IS BUILT ON A RATHER STEEP SLOPE, NECESSITATING AN UNUSUALLY LARGE AMOUNT OF EXCAVATION FOR A RESERVOIR OF THIS SIZE

Concrete was dumped directly from the mixer into a chute, and thence into hopper cars, which were used for transporting to the point of deposit. The track upon which these cars ran was supported on horses which were moved, and the track swung, to follow the progress of concreting. Spreading was done with shovels only, and the surface purposely left rough. Continuous concreting of the bottom was not attempted, dependence for securing waterproofness being placed in making all joints on a long scarf, and wetting, scrubbing and grouting all old surfaces previous to placing new concrete against them. Joints in the mortar finish were also kept away from joints in the base concrete.

APPLYING FINISH COAT

It was found nearly impossible to deposit the mortar for the finish coat while the concrete was green, and the attempt was abandoned. To obtain a bond, scrubbing with steel brushes and water was resorted to. This was followed by a sprinkling of cement, and that in turn by a sprinkling with water. The resulting cement cream was thoroughly scrubbed into the hard concrete, and lastly, the mortar coat of a ½-in. minimum thickness was deposited, and, after the proper interval of time, troweled to a sidewalk finish. Upon the suggestion of the writer, the concrete was sprinkled after initial set had taken place to remove laitance and so reduce the amount of scrubbing required. This proved to be a very successful expedient, as the particles of aggregate were left exposed and clean, embedded firmly in the concrete matrix, just as is the case where concrete has been rained upon before it is hard.

Springs, discharging about 20 gal. per minute, were encountered in the excavation. These were conducted by tile drains to the blow-off sump. When the walls of the latter were concreted, wrought-iron pipes were left to carry off this drainage. Upon capping these, it was found that the head thereon was too small to be injurious to the floor, and flow was accordingly shut off.

WATERTIGHTNESS

As soon as the last section of facing had hardened the bottom was flooded to the foot of the outer slope to facilitate curing. After a one week's wait, filling proceeded at the rate of between 1 and 2 ft. per day. No appreciable leakage was apparent, but dampness appeared along about two-thirds the length of the joint in the wall heretofore referred to, and at a few points where pockets of coarse aggregate had formed. The latter were all in the upper portion of the wall, where the section was thin, and where the spouts, on account of their construction and the position of the track, had delivered their contents obliquely against the outer forms instead of directly downward as in the lower wall. Vigilance had been exercised, during concreting, to spade the aggregate into uniformity at such points, but a few spots had escaped treatment, probably during the hours of darkness. After a few weeks most of this seepage had disappeared, but still persisted in parts of the horizontal joint. Accordingly, a coat of bituminous waterproofing was applied to the upper 12 ft. of the interior of the walls. Since this application no signs of dampness have appeared on the exterior. The outside of the exposed portion of the wall was painted with neat cement grout to improve its appearance. A cement gutter was constructed on the uphill berm to carry off storm water from the slope above. The berm and slopes were manured, and seeded with clover and timothy.

COSTS OF DULUTH CONCRETE RESERVOIR

	Unit Cost	Total
11,559.0 cu. yd. earth excav......	$0.529	$6,079.50
875.9 cu. yd. earth in trench....	0.75	656.93
1,331.9 cu. yd. rock excav........	6.00	7,991.40
299.7 cu. yd. gravel fill over rock	1.00	299.70
196 ft. 16-in. pipe laying.......	0.20	39.20
1,286.5 ft. 12-in. pipe laying......	0.15	192.98
706 ft. 8-in. pipe taken up......	0.10	70.60
93.8 cu. yd. class C concrete (filling)	3.00	281.40
335 lin. ft. cement gutter.......	0.50	167.50
1 valve chamber		100.00
1 blow-off pier		50.00
Reservoir proper, including ladder and steel		28,755.30
48.6 tons pipe....................	25.90	1,259.09
10,337 lb. specials................		402.31
Valves		351.40
Pipe hauling		54.22
Electric overflow alarm and conduit		59.28
Painting exterior with cement....		45.87
Inspection, including inspection of steel and cement................		358.57
Miscellaneous labor and material, including seeding		100.54
Total, exclusive of engineering and overhead		$47,315.79

The costs to the department of this structure and appurtenances, complete, is given in the table.

In the reservoir proper there are about 197 tons of steel and 1850 cu. yd. of 1:2:3 concrete.

TEMPERATURE CRACK AT CONCRETE JOINT

An observation as to the horizontal joint produced by interruption of concreting will no doubt be of interest. At the conclusion of work in November, and also about the first of the following June, the union of the layers at this point appeared to be complete. Before the reservoir was filled, however, a hair crack was visible following this joint for about two-thirds of its length. The writer believes this crack to have occurred on account of differences in temperature in the portions of the wall below and above the joint. The joint happened to be almost exactly at the level of the top of the earth embankment. This left the upper portion of the wall exposed to the hot sun, while that below was protected by the earth. The resulting stresses naturally produced cleavage at the plane of weakness caused by the joint at the critical point.

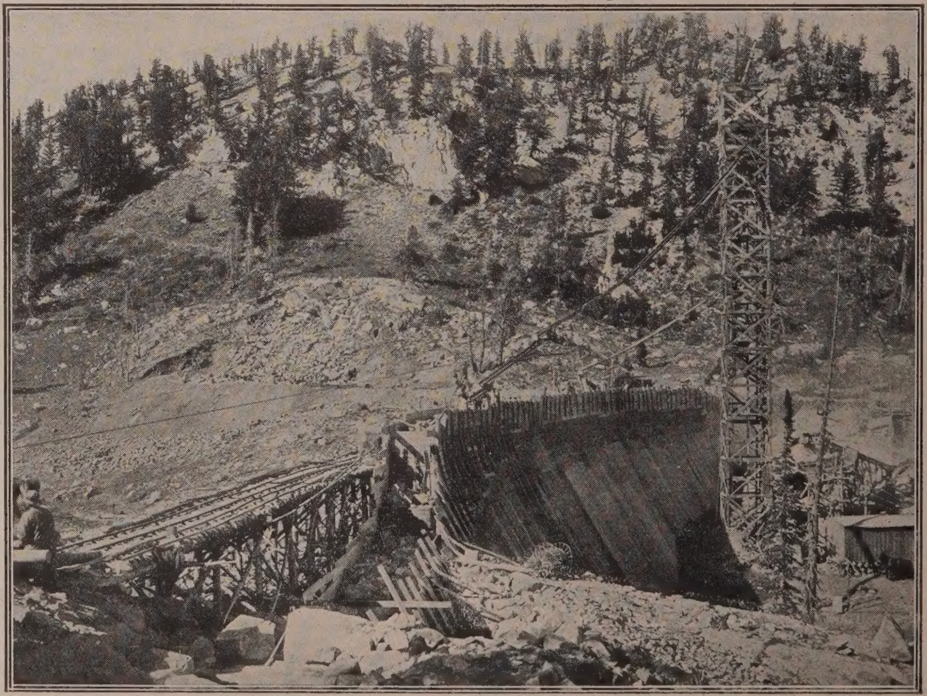
The points of interest which the writer has noted for subsequent practice are: A renewed sense of the difficulty of joining old to new concrete; the necessity for extreme care in arrangement of spouts when the same are to be used for depositing concrete; the thorough satisfaction given by the notched brackets used as a support for the horizontal wall reinforcement; and the feasibility of producing excellent concrete in below-zero weather, in an exposed situation, and with no protection other than the forms.

New Dam Increases Salt Lake City Water Supply

High Altitude of Dam Site Makes Short Construction Season—Only Proper Consistency of Concrete Will Flow Down Chutes

A NEW arched rubble dam forming the Twin Lakes reservoir at the head of Big Cottonwood Cañon adds 306,000,000 gal. storage capacity to the water supply of Salt Lake City. A short construction season, experience in getting proper moisture consistency of the concrete and the plant layout are the chief features of the construction.

The dam is 29 miles from Salt Lake, and the water runs down the natural bed for 15 miles before reaching the headgates at the mouth of Big Cottonwood Cañon, where it enters a reinforced-concrete conduit leading to the city. The crest is at an elevation of 9459 ft. above sea level, and the water surface with reservoir full is at El. 9456. The height is 56 ft. above stream bed and 69 ft. above bedrock. The maximum base width is 44 ft. and the top width is 6 ft. The arch has a radius of 670 ft. and a length of 650 ft. It is thrown across the outlet of the lower Twin Lake, a small basin of glacial formation near the top of the Wasatch Range. The topography of the country is such—as in practically all of the watersheds draining into the Salt Lake Valley—that there are no large sites available for the storage of water; but the pre-



ARCHED RUBBLE DAM WHICH WILL INCREASE SALT LAKE CITY WATER SUPPLY cipitation at this altitude for the locality is very heavy, particularly during the winter months. For the ten-month period beginning June 9, 1915, it was 37.36 in. As the dam has been under contemplation for some years, most of the excavation, relatively small in amount, had been done by city forces before the contractor began operations June 9, 1915. Work can only be prosecuted in this altitude from this time on to November. The work of laying bare the bedrock was completed July 15, so that concreting could begin. The entire work was finished Nov. 7, 1915.

CYCLOPEAN CONCRETE USED

The specifications for the rubble concrete provided for a 1:3:5 mixture of concrete in which granite stones in sizes from 6 in. to 4 ft. in dimensions were to be embedded, with spaces between stones of not less than 2½ in. The maximum size of stones actually placed did not exceed 2½ ft., and most of the rock did not exceed 2 cu. ft. Approximately 25 per cent of rubble was placed in the mass.

The rubble was obtained by stripping the bedrock and by quarrying from the hillside, 600 ft. distant. The sand and stone for the concrete were crushed from granite from the quarry, 400 ft. distant. A belt conveyor transmitted the sand and stone from the crushers, one gyratory and two jaw crushers, about 200 ft. to hoppers over the ¾-yd. Smith mixer at the foot of a distributing tower and to a stockpile. The rubble was transported to the forms in 1-yd. cars over a trestle built along the upstream face. The average amount of concrete placed was 74 cu. yd. per day of 10 hours, and the limiting features were the capacity of the mixer and the rate of furnishing the large stone.

In mixing and placing the concrete it was found that a slight excess of water caused the grout to separate from the aggregate to such an extent that it was practically impossible to handle the concrete satisfactorily. The best results were obtained by adding just sufficient water to make the concrete plastic. This mixture required steeper chutes. However, tests on 6-in. concrete cubes made of the plastic concrete showed higher strength than those made of the wet concrete. During the progress of the work 6-in. concrete cubes, made and tested in compression after 7 days and after 30 days, crushed under loads of 887 and 1992 lb. per square inch respectively.

QUANTITIES AND COSTS

The total quantity of rubble concrete was 9985 cu. yd., for which the contract price was $7.20 per cubic yard. For loose material and solid rock the prices were $2.25 and $3.50 per cubic yard respectively. Cement at Park City, the nearest railroad point, 7 miles from the site, was $2.17 per barrel.

The freighting of cement and other supplies to the dam site over the 7 miles of rough cañon road cost $5.90 per ton. This was accomplished by four-horse teams requiring 4 hours to make the trip up and 3 hours down. The estimated cost of crushed sand and stone was $2 per cubic yard and of rubble 50 to 60 cents. The dam proper costs $74,980, and the excavation $5,880.

James Stewart & Company were the contractors. The work was carried out under the direction of Sylvester Q. Cannon, city engineer.

Equipment Devised for Testing Water Meters Quickly in the Field

Methods Systematized for Checking Accuracy Without Removing Meters from the Property of the Water Consumers Who Own Them

By W. T. McCLENAHAN
Monmouth, Illinois

WHILE superintendent of a small water plant in Pennsylvania where there were about 3000 meters in use, the writer inaugurated a campaign of systematic testing of all meters already in service, as well as of all new and repaired meters going into service. As no record had been kept of tests in the past, and as some of the meters had been in service from six to ten years, it was necessary to test all meters. The testing was done largely by the regular shop force whenever other work did not require their attention. During a year's time the methods of making and recording the tests were greatly improved, and a description of them is given below.

We began making our tests by removing the meters and taking them to the shop for test on a calibrated tank. A short piece of pipe was substituted for the meter, so that the consumer was not without water while the test was being run. It took three men to run tests efficiently in this way—one man to remove the meters, one man to test them and one man to reset them. Generally the man who removed the meters brought in his load of meters to be tested and took out a load to be reset, but often one of the men was inexperienced and so was put to setting meters only.

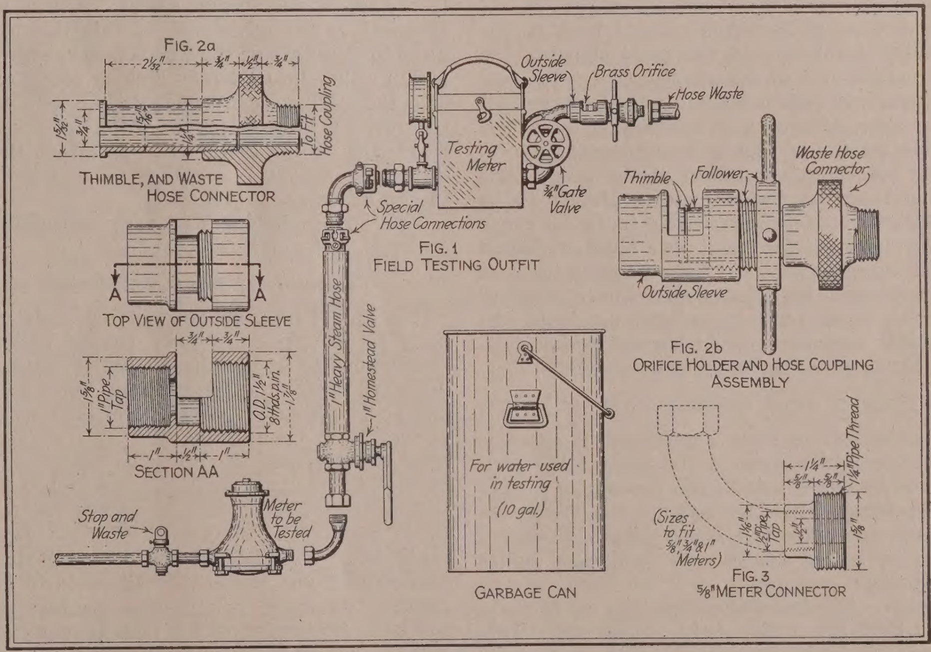


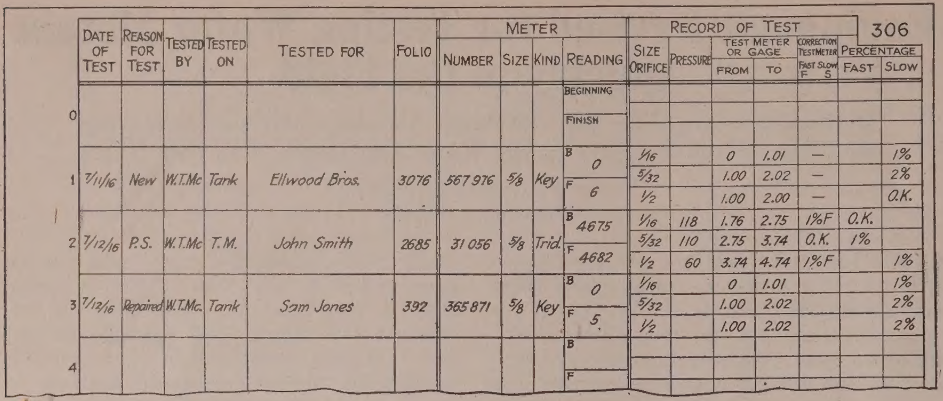
FIG. 1—DETAILS OF FIELD TESTING OUTFIT FOR METERS RANGING FROM FIVE-EIGHTS TO THREE-QUARTERS AND ONE INCH. FIGS. 2A AND 2B—DETAILS OF SPECIAL BRASS ATTACHMENTS FOR METER-TESTING OUTFIT. FIG. 3—CONNECTOR FOR FIVE-EIGHTHS-INCH METER

As the meters were owned by the property owner this method of testing meters very often caused trouble, for the property owner was likely to feel that we were taking liberties with that which belonged to him. A question also arose as to the accuracy of such tests made under conditions different from those which prevailed in the house. The basis of the contention is that there is a difference of pressure, a disturbance of sediment in the meter and a change in the running position of the meter when it is tested in the shop. There is some truth in this contention, but from our experience with this method and with the test meter method described in the following paragraphs the writer would hesitate to say that the test meter is the more accurate. While it overcomes some of these faults, it introduces others that may be just as serious. Our experience showed that particles of sediment are likely to get into the test meter and interfere with its proper working. However, with proper care taken to watch the regularity and smoothness of the action of the test meter during the tests and a frequent checking up of the test meter on the tank, reliable results can be obtained.

There is usually less objection to making tests on the property without the removal of the meter, and there is also a psychological effect on the consumer which favors the test meter. The consumer seems to be favorably impressed in most cases when he sees an array of equipment brought to his cellar and sees the test made, even though he may not fully understand it. Our men were instructed to explain the test whenever the property owner wanted to know about it.

From our experience it would seem that there is very little difference in the cost of making the tests by the two methods. Present practice is to test with the test meter where it can conveniently be used, but to remove the meter and test at the shop if the test meter cannot be easily connected in. With this modification in method the test meter method is a little cheaper.

Two men are required to make tests with the test meter. One man should be an intelligent, resourceful laborer who knows



306

	DATE OF TEST	REASON FOR TEST	TESTED BY	TESTED ON	TESTED FOR	FOLIO	METER				RECORD OF TEST						
							NUMBER	SIZE	KIND	READING	SIZE ORIFICE	PRESSURE	TEST METER OR GAGE FROM	TO	CORRECTION TEST METER FAST SLOW F S	PERCENTAGE FAST	SLOW
0										BEGINNING							
										FINISH							
1	7/11/16	New	W.T.Mc	Tank	Ellwood Bros.	3076	567 976	5/8	Key	B 0	1/16		0	1.01	—		1%
											5/32		1.00	2.02	—		2%
										F 6	1/2		1.00	2.00	—		O.K.
2	7/12/16	P.S.	W.T.Mc	T.M.	John Smith	2685	31 056	5/8	Trid.	B 4675	1/16	118	1.76	2.75	1%F	O.K.	
											5/32	110	2.75	3.74	O.K.	1%	
										F 4682	1/2	60	3.74	4.74	1%F		1%
3	7/12/16	Repaired	W.T.Mc.	Tank	Sam Jones	392	365 871	5/8	Key	B 0	1/16		0	1.01			1%
											5/32		1.00	2.02			2%
										F 5.	1/2		1.00	2.02			2%
4										B							
										F							

FIG. 5—REPORT CARD IS COMPILED BY MAN TESTING THE METER

how to figure percentages and can keep a clean, reliable record. The other man is a helper and can be an ordinary cheap laborer.

The heart of the testing apparatus used by us is the test meter. Other meter companies make test meters, but the one we happened to use was a ¾-in. split-case Neptune meter. It is inclosed in a neat wooden carrying case and is provided with a special dial with two hands, the smaller reading to feet up to 10 cu. ft. and the larger reading to hundredths of feet up to 1 cu. ft. If the meter to be tested records 1 cu. ft. for every revolution of the hand showing the smallest unit of consumption, then the test meter will record directly in percentage fast or slow, according as the test meter shows hundredths of feet less or more than 1 cu. ft. for every revolution of the small digit hand on the tested meter. Meters to be tested which do not record 1 cu. ft. for every revolution of the small digit hand are tested in the same way, but the percentage fast or slow must be calculated. Where most of the meters read in gallons, no doubt the meter companies could furnish a dial suitable to give results in percentages.

HOLE IN DISK GOVERNS RATE OF FLOW

The rate of flow is governed by the size of the hole in a round, flat brass disk which was formerly inserted in a coupling on the discharge side of the test meter. The meter is connected up in series with the meter to be tested so that all the water going through one meter will go through the other. The lid of the carrying case is made to hold the orifice disks not in use. This was the outfit purchased from the meter company.

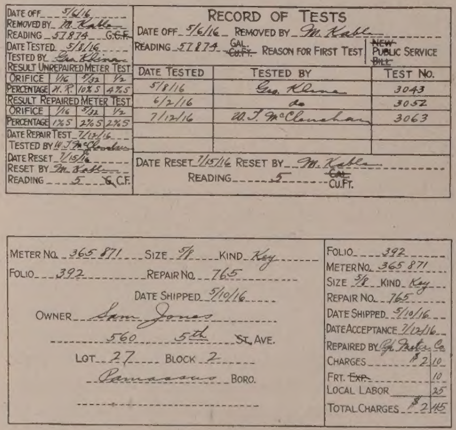
In testing meters we ran three tests. The first test was always the highest rate of flow and was intended to correspond as nearly as possible to the rated capacity of the meter being tested. The next test corresponded as nearly as possible to that specified for test by the Public Service Commission of Pennsylvania. The last test run was on a very small flow which was supposed to correspond to a leak and was usually about one-thirtieth of the rated capacity of the meter. It was the writer's observation that most of the time spent in making tests was consumed in setting up the apparatus and in changing the orifice disks. He therefore designed an orifice holder to shorten the time required in making the changes of disks and connecting equipment between the two meters to speed up the work of setting up and disconnecting the apparatus.

Instead of the clumsy coupling into which the orifice disk was inserted and then screwed onto the discharge end of the test meter, the writer had the special orifice holder shown in Figs. 2a and 2b, made of brass and permanently screwed to the discharge end of the test meter. It consists of three distinct parts—an outside sleeve which fits on the end of the test meter, a follower which screws into the outer end of the outside sleeve and fits snugly around the thimble and a hose piece. The follower pushes the end of the thimble piece against the orifice disk which is inserted in the slot in the top of the outside sleeve. A hose is attached to the other end of this thimble piece to take care of the waste water, which is run either into a handy sink or sewer or into the garbage can which is carried for the purpose. Three lengths of hose are carried—3 ft., 10 ft. and 20 ft. To attach the hose the follower is loosened up and then the milled wheel is turned.

This orifice holder was very successful and was well worth the cost.

CONNECTION BETWEEN METERS

The connection between meters consisted of a set of three ordinary curved meter connections to fit the three sizes of meters ordinarily tested, a quick-closing valve and two short pieces of heavy steam hose with special hose connections and two curved hose connections. In order to make convenient the changes which are necessary in testing the different sizes of meters, special brass male ends, shown in Fig. 3, were made to fit the ends of the curved meter connections, and these were all made to fit into a standard 1-in. meter connection screwed into the end of the 1-in. Homestead valve. The Homestead valve was chosen because it is quick-closing, is well made and will stand the wear. It is used in stopping the test when the small digit hand on the meter being tested has made exactly one revolution. It must be placed near this meter. The slow-opening gate valve at the test meter is used to start the tests, as it was found that there was a certain amount of error introduced because of inertia of parts when water was allowed suddenly to start through a meter.



DATE OFF 5/6/16
REMOVED BY M. Kable
READING 57874 G.C.F.
DATE TESTED 5/8/16
TESTED BY Geo. Kline
RESULT UNREPAIRED METER TEST

ORIFICE	1/16	5/32	1/2
PERCENTAGE	H.R.	10% S	4% S

RESULT REPAIRED METER TEST

ORIFICE	1/16	5/32	1/2
PERCENTAGE	1% S	2% S	2% S

DATE REPAIR TEST 7/12/16
TESTED BY W. T. McClenahan
DATE RESET 7/15/16
RESET BY M. Kable
READING 5 ~~G~~ C.F.

RECORD OF TESTS

DATE OFF 5/6/16 REMOVED BY M. Kable
READING 57874 GAL. ~~CU.FT.~~ REASON FOR FIRST TEST ~~NEW~~ PUBLIC SERVICE ~~BILL~~

DATE TESTED	TESTED BY	TEST No.
5/8/16	Geo. Kline	3043
6/2/16	do	3052
7/12/16	W. T. McClenahan	3063

DATE RESET 7/15/16 RESET BY M. Kable
READING 5 ~~GAL.~~ CU.FT.

METER NO. 365 871 SIZE 5/8 KIND Key
FOLIO 392 REPAIR NO. 765
DATE SHIPPED 5/10/16
OWNER Sam Jones
560 5th ST. AVE.
LOT 27 BLOCK 2
Parnassus BORO.

FOLIO 392
METER NO. 365 871
SIZE 5/8 KIND Key
REPAIR NO. 765
DATE SHIPPED 5/10/16
DATE ACCEPTANCE 7/12/16
REPAIRED BY Pgh. Meter Co.
CHARGES $2.10
FRT. ~~EXP.~~ .10
LOCAL LABOR .25
TOTAL CHARGES $2.45

FIG. 4—FILING AND REVERSE SIDES OF CARD FOR METER-TEST RECORDS

The special hose connections were made by the W. J. Clark Company of Salem, Ohio, and are what are known as "Quick as Wink" couplings. They are made up by simply pushing the one into the other. They are taken apart by inserting a key into the jaws of the clamp which holds the coupling together and turning it through 90 deg. They were very quickly handled and never gave trouble or leaked. They were indeed so satisfactory that the writer believes they could be used to advantage on the discharge hose also. The two pieces of short hose and the two curved hose couplings are found very useful in making certain connections.

GAGE RECORDS PRESSURE

A small gage was placed permanently next the test meter so that a record of the pressure obtained at each house during each test could be noted. Such information is of value not only in calculating the exact rate of flow during each test but furnishes valuable information that is useful for other purposes.

A special wrench was made to fit the two most common sized meter nuts—the ⅝-in. and the ¾-in. meter.

Other equipment carried is listed in the table. A specially designed cart was made to carry everything in its place, so no time was lost in collecting the equipment and nothing was forgotten. That cart did service for testing only, and the equipment was not to be taken from it.

MISCELLANEOUS EQUIPMENT

- 1 10-in. pipe wrench.
- 1 12-in. monkey wrench.
- 1 screwdriver.
- 1 flash light.
- 1 meter sealing iron.
- 1 pair wire cutters.
- 1 spool copper sealing wire.
- Supply:
  - ½-in. lead seals.
  - Seal bolts.
  - Seal screws.
  - Meter nut seals.
  - Candles
  - Leather washers for ⅝, ¾ and 1-in. meters.
- Assorted lot bushings, nipples, etc.

It had a cover which could be locked to keep out thieves when it was left out on the street. In winter a lantern was carried in the cart to prevent freezing of the equipment.

RECORD SYSTEM

In handling meter tests and repairs our local office made certain reports to the general office in Pittsburgh. The property owners usually delivered the meters needing repair to us, and we would then send them to the factory, where they would be repaired and the charges billed to us for collection. These two facts explain the form and the reason for some of the information appearing on the meter card shown in Fig. 4. The card as here shown is not exactly as used at the time the writer was connected with the company but is the improved form we intended to use as soon as our supply of old cards was used up.

The meter card is made in two parts and is printed on both sides. The upper part of Fig. 4 shows the face of the card and the lower part shows the reverse side. When a test is desired on a meter, or a meter damaged by frost or other agency is to be repaired, the face of the card is filled out in the office and the card given to the shop man, who tests the meter or removes it, as the case may require. On the back of the card the shop man is told the reason for the test, whether new, a routine test as required by the Public Service Commission or a test desired by the consumer because of an excess bill. If all these reasons are crossed out the shop man understands that the meter is to be removed and repaired.

The left-hand part of the face of the card is a standard 3 x 5-in. filing card, and remains in our local office. The stub goes to the general office and gives the information it wants. An ordinary pair of shears or a coupon machine can be used to clip the stub from the card. It was found that this style of card has advantages over a system using two cards or a card and a slip report, for the latter system is cumbersome, and the two parts are likely to become separated and one part lost or overlooked. Where the two parts are attached till the report is completed this cannot happen, and the shop man does most of the work of filling out the blanks, thus saving the office force a lot of work.

The card is either attached to the meter or slipped under the lid while it is being handled in our shop, but is removed when the meter is shipped to the factory.

The cards are filed in the office according to meter number, and for that reason the meter number appears at the top. The folio is the account number in our register. Repair number is a number given consecutively to the repair orders, and is useful in handling repairs, and indicates the number of repairs done in a given time. Date shipped shows when the meter left for the factory, and date accepted indicates when the meter passed our tests after it was repaired. The time that a meter is away at the factory is sometimes interesting information. The charges are those billed by the meter company, and the total charges are those charges plus the freight and local labor charge.

On the back of the card appears the history of the test and the time off for repair. The first test listed is always the unrepaired meter test, unless all the reasons for test are marked out, which would indicate that the meter was damaged and no unrepaired meter test run.

If this matter has been overlooked, the test card described later will give the reason for test. Extra lines are provided in the test-record table for extra tests made on repaired meter when it failed to pass our requirements. The last test shown indicates the test when the meter was finally accepted. All these blanks on the back of the card are filled out by shop men.

The man testing the meter also makes out a test card, shown in Fig. 5. Both the meter card and the test card are original records and are filed in standard filing cabinets. The test card is filed by the page number appearing in the upper right-hand corner. The test number indicates the page and line in the test record where the test can be found. For instance, test number 3062 refers to test page 306, as shown by the figure in the upper right-hand corner of the test card and line 2 as given in the left-hand margin. It would refer to a test on meter 31056 owned by John Smith. The number also indicates that there have been 3062 tests run since the system was started.

Most of the columns in the test record are self-explanatory, but perhaps some of them need a little explanation. Under the column entitled "Reading" appears a division of the test line into two parts. The upper part is labeled "Beginning" and refers to the reading of the meter to be tested before any water is used in testing. The lower part is labeled "Finish" and refers to the reading of the meter after the test is completed. Consumers often complain that water is wasted for them during the test, and if these figures are recorded they are generally satisfied that the amount is insignificant, or if it really does amount to something the amount is exactly known.

Pressure is that shown by the gage while each test is being run and is of value in determining the rate of flow through the orifice and for other obvious reasons. Usually the rate is not calculated and is assumed to be the same as determined at the shop, but the data are furnished so that the rate can be calculated if occasion arises.

Correction of test meter is the amount the test meter has been shown to be fast or slow when tested on the tank in the shop. These corrections should be applied before setting down the percentage fast or slow in the last two columns.

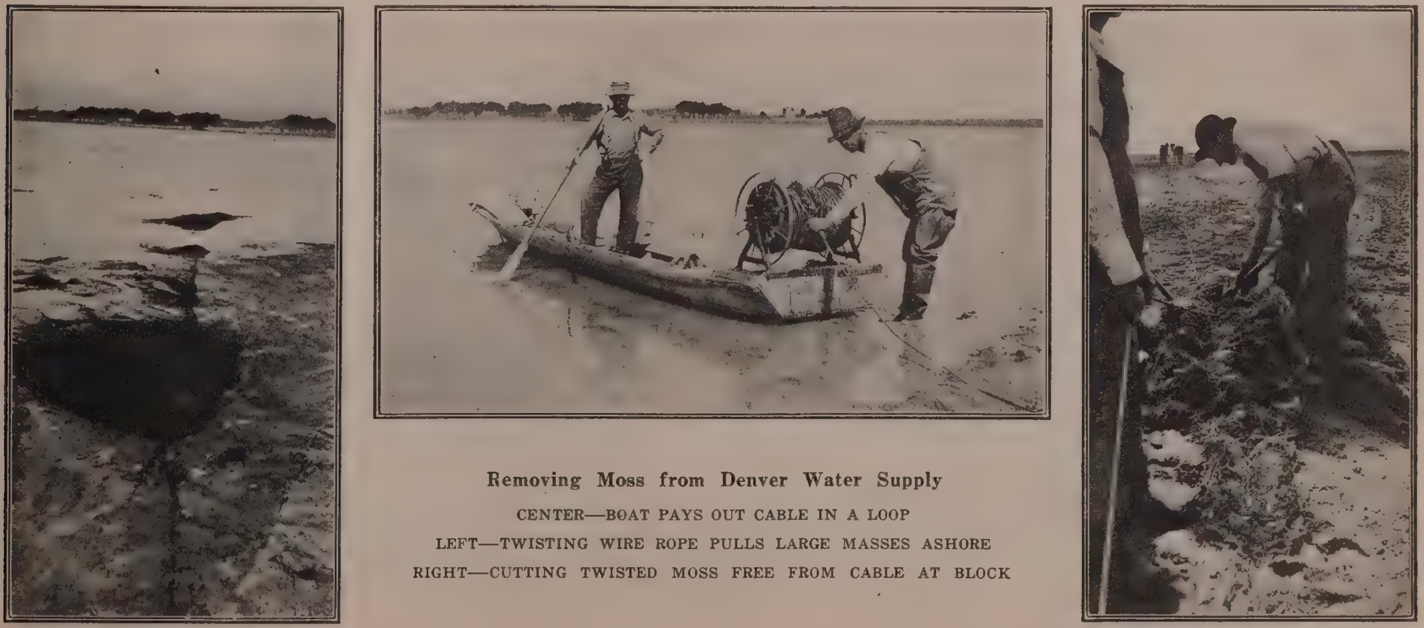
It may be said by some that the system is complicated and asks for too much information, but it calls for information only on points that have arisen in actual practice. Most of the clerical work is done by the field men, and if these men make use of their spare moments it costs no more to get the information complete than it does to get it incomplete. The system is intended to obviate the necessity of duplicating work and records. Of course it would be modified where the meters are repaired by the shop men or where different information is wanted by the main office.

Wire Rope Removes Moss from Lake Water Supply

Reduction in Algæ Growth Is Effected and Screen Washing Is Cut Down—Two Gangs Keep Shallows Near Five-Mile Shore Line Clean

LONG, tangled strands of green moss, which grows prolifically in the shallow portions of Marston Lake, a 6,000,000,000-gal. storage reservoir supplying Denver, are cut loose from the bottom and partly removed by a 1000-ft. length of $\frac{3}{8}$-in. wire cable. The portion not dragged to shore by the cable, 50 per cent, floats, and is blown to the shore in a short time.

The water-company engineers have a theory that the more of this moss that can be removed the less trouble they will have with algæ growths. In fact, during the 1916 season, when more care than ever was taken to remove the moss, it was not necessary to give the lake its usual treatment with copper sulphate. This treatment is not given until anabæna reaches 500 standard units per cubic centimeter, or other odor-producing organisms reach corresponding objectionable counts. It has been found that algæ are extremely sensitive to changing conditions, so that it will require several seasons' operation to make sure that the algæ have died out owing to the lack of moss, and not just encountered a natural death. The present high cost of copper sulphate makes the proposition an economical one, to say nothing of the very much improved condition of the shallows near the shore line, which is skirted by



Removing Moss from Denver Water Supply

CENTER—BOAT PAYS OUT CABLE IN A LOOP

LEFT—TWISTING WIRE ROPE PULLS LARGE MASSES ASHORE

RIGHT—CUTTING TWISTED MOSS FREE FROM CABLE AT BLOCK an automobile road much traveled by consumers. The decaying moss causes trouble in the screens, the washings increasing from 10 to 100 per day. The filters are also clogged unduly, because it is not possible to screen out all of the fibers in the decaying stage.

Six men, one team, and a boat with a reel in the stern form the outfit to cut the moss with the 1000-ft. cable. The procedure is to anchor one end on shore, and, with the rope wound on the reel, to row straight out from shore about 400 ft. and return in a loop to the shore, about 100 ft. away from the starting point. The team is then hitched to one end of the cable and pulls it ashore. For flexibility, a 1½-in. manila rope, 50 ft. long, is attached to each end of the 18-strand wire cable. The cable runs through a large block, which four men anchor to the ground by a bar and rope, to collect the moss at a point about 50 ft. from the water's edge. One man, with a sharp spade, makes a cut along the cable to free it from the moss which is wound around the cable in a thick rope, and gathers other portions at intervals 1 to 2 ft. in diameter. The team makes two pulls of 500 ft. each. There are five swivels in the cable to permit as much twisting as possible, for it is the twisting that increases the amount of moss entangled. Formerly, barbed wire was used, but the team broke it. It was intended to wrap the cable with barbed wire to entangle the moss, but it was not found necessary.

Moss Is Piled

Final disposal of the moss is made by collecting it in large piles about a mile apart. Two wagons and a gang of eight men gather the floating moss and load the piles pulled in by the cable. They wade into the shallows with rakes and pitchforks. The moss is 95 per cent water, and is burned after it dries out. It is not thrown around promiscuously, for it kills vegetation, and the shores above the high-water line are sown to wheat or rye. These cutting and collecting crews work continuously during July and August on about 5 miles of shore line, 1 mile of which is riprapped with stone.

Care of the banks of all the Denver reservoirs above water has received much attention. The steep outsides of fills are covered with alfalfa, which has extremely long roots. The inside slopes are planted to some small grain crop, so that the straw can practically all be removed. Below the high-water line to the existing shore line the area is disk-harrowed at sufficient intervals to keep all vegetation from growing.

The care of the Denver Union Water Company reservoirs is in charge of the engineering department, of which D. G. Thomas is chief engineer.

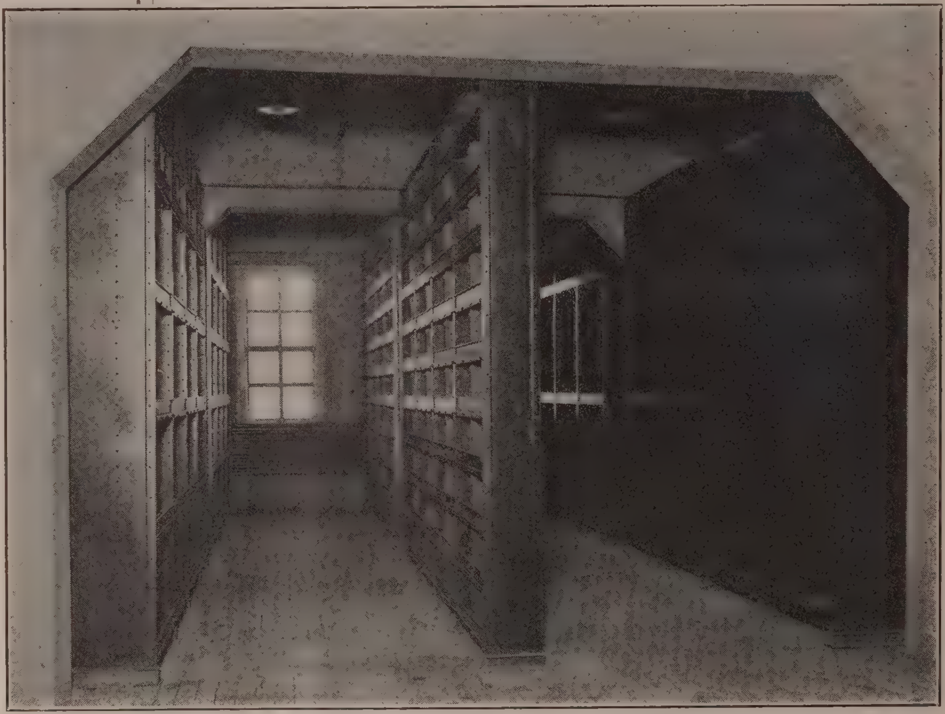
Panama Traffic in Five Months Compares Well with That of 1915

Despite the closing of the Panama Canal from the middle of last September to the middle of April, leaving only five months of operation in the year ended June 30, the net tonnage carried through the canal was 2,479,761, or 64.5 per cent of that of the previous year, according to figures presented in the *Canal Record*. The tolls were $2,399,830.62, as compared with $4,343,383.69 in 1915. The total number of vessels passed were 1088 in 1915 and 787 in 1916.

Blower System Ventilates Railway Blacksmith Shop

Other Features of Bessemer & Lake Erie Shops Include "First-Aid" Room and Two-Story Reinforced-Concrete Storehouse

Among the features to which the engineering and motive-power departments of the Bessemer & Lake Erie Railroad call the attention of the visitor to the railroad's main shops at Greenville, Pa.—shops that have mostly grown up in the last ten years—are the blower and exhaust system in the blacksmith shop, as a result of which it is facetiously stated that men go into and not out of the shop for fresh air; a "first-aid" hospital in one of the shop buildings where prompt treatment of injuries saves much lost time and discomfort to the men; and a two-story reinforced-concrete storehouse with an elevator and an orderly system of steel shelving, replacing a one-story frame building such as is found in many a railroad yard.


STEEL SHELVING AND AMPLE WINDOWS MAKE FOR ORDER IN STOREHOUSE

In the blacksmith shop the officials of the company believe they have gone as far in promoting the comfort and efficiency of the workmen as has been done anywhere. Under the floor of the shop are two independent pipe systems for ventilation, a blower system and an exhaust system. In one corner of the shop are the three fans—two blower fans and an exhaust fan. The blower system starts with two 15-in. lines, which branch off and taper down to smaller sizes to reach each machine. The exhaust line reaches a diameter of 36 in. at the fan. A separate blower outlet and exhaust inlet reach each forge, and in addition a blower outlet reaches every other machine. Thus all dust and gases are sucked away from these forges, and are replaced by fresh air.

A plan is maintained showing the exact location and size of every part of the system, and when new machines are placed they are fitted to the system.

Further contributions to the comforts of the workmen are the white paint with which the interior walls of the shop have been coated and the light window shades to shut out the strong sunlight. As a commentary on the cleanliness of the place, it is pointed out that the paint, though not quite so light as when applied eighteen months ago, is still cleaner than would be expected on the exteriors of buildings in that vicinity. The "lace curtains" have also retained most of their freshness.

The first-aid hospital is equipped to minister to the numerous minor injuries that would otherwise send the victims home, and to provide temporary relief to those more seriously injured, who must be taken afterward to the city hospital. A large number of the cases treated are caused by filings or other foreign matter entering the eye, and in these cases, both because the treatment is prompt and because the hospital is specially equipped for such relief, the advantage of the first-aid hospital is apparent.

Only half of the concrete storehouse has been built up to this time. Part of the old frame structure was torn down to make room for it, and when the transfer of stores to the new building has been completed the old storehouse will be used for storing frogs, switches, heavy castings, etc., until some future time when requirements necessitate an extension to the new concrete building.

The new storehouse is something more than a mere shelter from the elements, dark and dingy, expected to take any junk thrown into it. The new building, besides minimizing the fire risk, is designed to facilitate classification as well as storage. A feature is the rows of steel shelves, which, as the photograph shows, are of various sizes, and adjustable. Shelving of this type was thoroughly tested before the equipment for the building was ordered.

As the new storehouse has two floors, a large elevator will handle material. On the second floor is also a commodious lavatory.

These shop improvements have been carried out under the general direction of H. T. Porter, chief engineer, and G. M. Gray, superintendent of motive power.

Local Water Tested by Laboratory on Wheels

Railroad Car Equipped with Chemical and Bacteriological Apparatus to Control Water Supplies

By J. H. O'NEILL
Sanitary Engineer, Louisiana State Board of Health

THE REAR END OF THE RAILROAD CAR SERVES AS A GARAGE FOR A SMALL AUTOMOBILE

IN ORDER to increase the efficiency of its control of water supplies and to be able to send a laboratory to any point in the state to aid in fighting epidemics which might occur, the Louisiana State Board of Health has equipped and put into service what is probably the first car of its kind in the country. A railroad car, formerly used as a private car, was purchased and remodeled to a design prepared by the board's president and technical staff. Space is provided for a laboratory for chemical and bacteriological work, a power plant, two toilet rooms with shower baths, one section with four berths, a dark-room for photographic work, two large lockers, office, and garage for a small automobile.

The power plant consists of a two-cylinder gasoline engine direct-connected to a 1¾-kw. dynamo, which furnishes current for lights, fans, an electrically heated incubator with electric thermostat control, and an air pump. A 20-gal. gasoline tank is suspended beneath the car. A 3-gal. tank hung on the wall of the lavatory next to the engine room supplies the carbureter of the engine by gravity flow. Gasoline is forced from the storage tank to the small tank by compressed air as needed. A vacuum system was first used to supply the engine directly from the storage tank, but proved unsatisfactory. An electrically driven air pump keeps up pressure in air-storage tanks. The engine room has an exhaust fan in the ceiling.

LABORATORY EQUIPMENT

The bacteriological laboratory is equipped with sterilizers, autoclave, centrifuge, microscope, etc., for the making of media and practically all kinds of bacteriological analyses and diagnostic work. Supplies of anti-typhoid vaccine and culture tubes for throat swabs are carried.

At present the chemical laboratory is equipped for the analysis of milk and water. An exhaust fan and three ceiling fans provide ventilation. In one corner of the laboratory is a fume chamber with acid-proof light and exhaust fan. Glassware, such as beakers, burettes, pipettes, etc., is carried in racks specially designed for each type and size. Flasks and delicate glassware are carried in compartments lined with cotton batting. Heat for autoclave, stills, etc., is furnished by alcohol stoves of various sizes. The scale beam and pans of the balance are dismounted and carried in racks when the car is moved.

Three water storage tanks suspended beneath the car have a capacity of 500 gal. Compressed air is used to lift water into the car. The car is equipped with a gravity hot-water system, which comprises a heater, two tanks each of 80 gal. capacity suspended from the ceiling of the engine room, and a circuit supplying laboratory and toilet rooms.

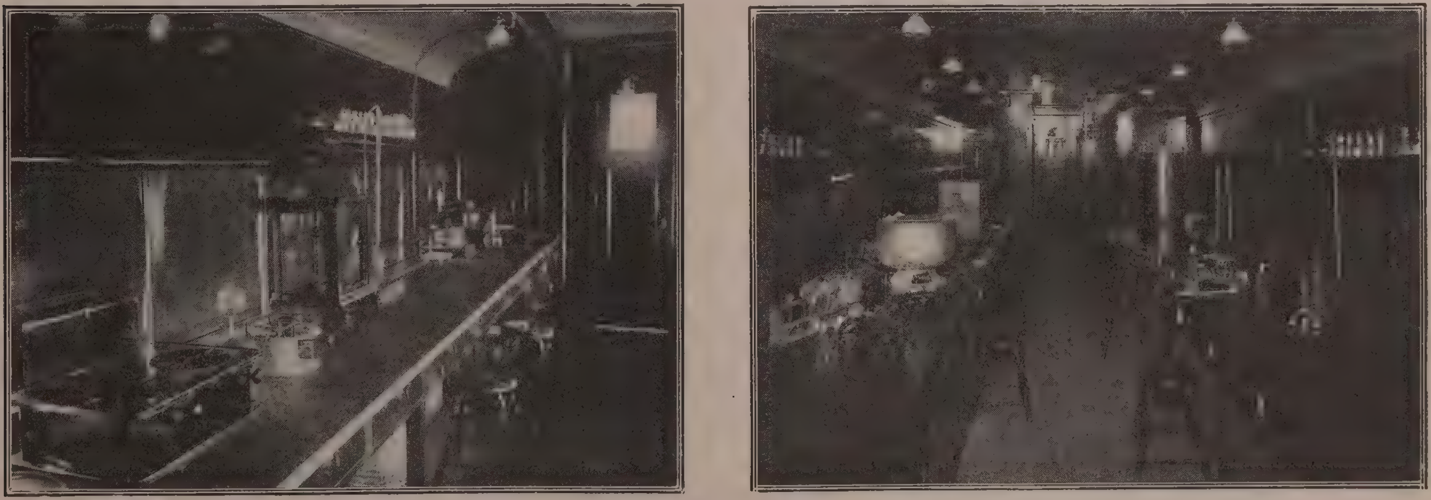
The section containing the berths is for the porters. The laboratory staff and inspectors are provided for by another car.

The dark-room, though small, is fully equipped, one interesting point being that the wash sink is supplied with ice water from a coil in the refrigerator. This is a great convenience when it is necessary to wash films or plates in hot weather.

The office has two bookcases and typewriter desks.

The garage is large enough to carry a small automobile and a motorcycle. These are loaded and unloaded on skids built up of channel irons. Along each side of this room are benches which let down against the wall when not in use. On the wall at one end are two small tables similarly hung. This room is used as a demonstration room or for conferences with local authorities.

The car has recently completed a tour of all the railroad lines in the state. The use of the automobile makes it possible to cover a much larger area and also decrease the number of stops of the car, the usual practice being to collect samples along the shorter branch lines and at places between the stops of the laboratory car.



A PRIVATE RAILROAD CAR HAS BEEN CONVERTED INTO A LABORATORY COMPLETELY EQUIPPED WITH CHEMICAL AND BACTERIOLOGICAL APPARATUS FOR MAKING ANALYSES .

Follow This Advice in Cold-Weather Concreting

Portland Cement Association Outlines Precautions Which Will Insure Sound Work During Winter Months

TO INSURE the integrity of concrete placed during cold weather the Portland Cement Association, of Chicago, is calling attention to a number of precautions which should be taken by contractors and engineers in charge of winter work. This timely advice will soon be published in pamphlet form by the association. The substance of an advance copy, which will bear the title "How to Do Concrete Work in Cold Weather," follows:

HEAT SAND AND STONE

Concrete work can be carried on successfully in cold weather. All that is necessary is to heat the sand and pebbles or broken stone and mixing water so that the concrete mixture will have a certain minimum temperature, then place the concrete quickly and maintain the heat until early hardening has been completed. This does not mean that there are no limitations to the practicability of doing concrete work in cold weather, but that if a few simple precautions and protective measures are used, winter concrete work will be as successful as that done in warm weather.

Many contractors have found their working season profitably lengthened by using these precautions and protective measures. Men and equipment can be kept employed almost regardless of season. In this way the contractor can keep his efficient organization together. The resulting advantages are far greater than the seeming disadvantages—principal among which is that the application of the necessary precautions slightly increases the cost of cold-weather work. This, however, is usually offset by the builder's willingness to pay for the privilege of having the use of his building or structure earlier than would be possible if work were postponed until warm weather.

During the first few days following the placing of concrete, alternate freezing and thawing at comparatively short intervals will damage it. It is necessary, therefore, to mix, place and protect the concrete so that early hardening will be complete before the work is exposed to freezing temperatures. To do this: (1) Sand and pebbles or broken stone used must be free from frost or lumps of frozen material. (2) If these materials contain frost or frozen lumps, thaw them out before using. (3) As cement forms but a relatively small bulk of the materials in any batch of concrete, it need not be heated. (4) Mixing water should always be heated.

DANGER IN SALT

Although adding common salt to mixing water will prevent freezing of concrete that has not hardened, there is a limit to the quantity of salt which may be added if the final strength of the concrete is not to be affected. Salt simply lowers the freezing point of the mixing water; it does not supply what is most needed—heat and warmth. It delays, instead of hastening, the hardening of the concrete. Sand and pebbles or broken stone and mixing water must be heated so that the concrete when placed shall have a temperature of from 75 to 80 deg. Some sands are injured by too much heat. The same applies to certain varieties of pebbles and broken stone. A temperature not exceeding 150 deg. Fahr. will generally prove most satisfactory.

Place concrete immediately after mixing, so that none of the heat will be lost before placing in the forms. Warm the metal forms and reinforcing before placing concrete. Be careful to remove ice and snow and frozen concrete remaining on the forms from preceding work. Forms can be warmed by turning a jet of steam against them or by wetting with hot water.

PROTECT FINISHED WORK

Even though materials have been heated and the concrete placed immediately after mixing, it will lose much of its heat if not protected from low temperatures. Protect the concrete immediately after placing. Canvas covering, sheathing, housing in the work, or hay or straw properly applied will furnish the required protection for some work. In addition to these means, small oil or coke-burning stoves or salamanders may be used in inclosed structures.

Temperatures which may not be low enough to freeze the concrete may, nevertheless, delay its hardening for a considerable time. Do not expect concrete placed when the temperature is low and remains low for some time afterward to be safe for use as soon as that placed during warmer weather. If concreting is unavoidably delayed or interrupted the work should be covered until concreting is resumed. Cover and protect any sections of the work as soon as completed. In severe cold weather continue this protection for at least five days.

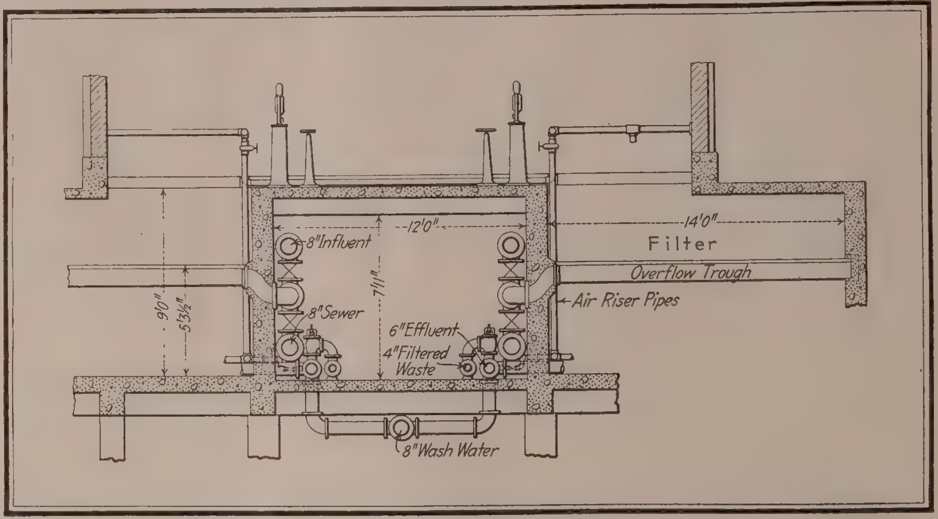
Forms must not be removed from the concrete work too early. This applies to any concrete work, regardless of season, but is particularly important with work done during cold weather. Frozen concrete sometimes very closely resembles concrete that has thoroughly hardened. When frozen concrete is struck with a hammer it will often ring like properly hardened concrete.

Special Devices Installed to Improve Operation of New Mechanical Filters

At Chillicothe, Mo., Chemical Feed for Coagulation Is Automatically Proportioned to Flow—Rate Controllers Regulate According to City's Demand for Water

By **E. E. HARPER**
Consulting Engineer, Kansas City, Mo.

A CIRCULAR coagulating basin, automatic proportional chemical feed devices, an unobstructed pipe gallery, draft tubes for washwater, supplemental coagulation at each filter unit and rate controllers which regulate the flow automatically in accordance with the demand for water in the city—these are a few of the features at the mechanical filtration plant which has recently been completed for the city of Chillicothe, Mo., which has a population of 10,000 and obtains its supply from the Grand River. The river water is pumped by De Laval centrifugal units a distance of 2 miles to a 1,800,000-gal. rectangular, concrete-lined settling basin, 120 x 200 ft. in plan. Thence it passes through the coagulating basin to the filter.



THE PIPE GALLERY IS DESIGNED TO AFFORD UNOBSTRUCTED PASSAGE

The coagulating basin, of reinforced concrete, is circular, 42 ft. inside diameter, 11 ft. deep, and has side walls 12 in. thick. So far as the writer is aware, this is the first circular coagulating basin built in this part of the country. The baffle walls are also circular, and the whole construction is such that all sharp turns and dead spaces are eliminated, as the raw water, after being treated with the proper dose of coagulant, enters at the center of the basin and flows in an ever-widening circle until it is ready for the filters. A basin of this type costs only about two-thirds as much as a rectangular basin of the same capacity, and is, the writer believes, more efficient.

The mixing chamber is a triangular space in a small compartment in that part of the basin which extends underneath, and is inclosed by, the filter house. Here the raw water is discharged through an orifice plate of such size that 700 gal. per minute produces a jet about 9 in. high, and the chemicals are discharged in a stream at this point and thoroughly mixed with the stream as it falls from the orifice. The treated water then passes a series of wooden baffles and flows through the pipe leading to the center of the basin.

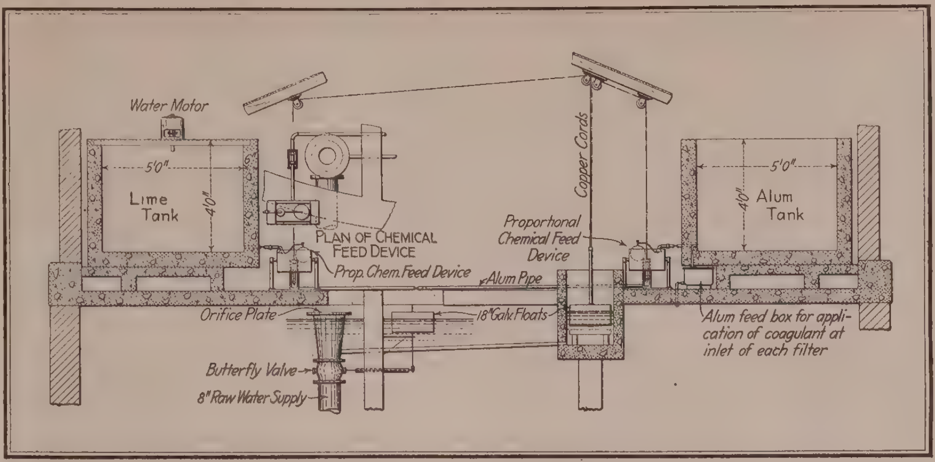
Coagulants, lime and alum are mixed in circular concrete tanks and discharged through chemical feed devices which automatically proportion the flow of coagulants to the amount of raw water pumped to the coagulating basin. Each device consists essentially of a small tank, called the tilting tank, cylindrical in form, about 10 in. in diameter and 15 in. long, open on one side, with closed ends, and fitted to rotate 30 deg. about its major axis and approximate center of gravity. Attached to one side of this tank is a spout or piece of pipe about 18 in. long, the end of which is fitted with an adjustable orifice. This tank is kept filled to a uniform height with the chemical solution, regulated by a float valve, as in the usual type of orifice box.

The tilting tank is actuated by means of a cable fastened to the end of the spout thereon, running over suitable pulleys, and attached to a large float, which in turn is moved up or down by changes in the water level of a small tank that is connected, by means of piping, to the pipe through which raw water is discharged into the coagulating basin. In operation, the coagulant is therefore discharged from the tilting tank, through the orifice on the end of the attached spout, under the same head as the raw water is discharged through its orifice into the coagulating basin. The chemical feed is always in exact proportion to the amount of raw water entering the coagulating basin, and the quantity of water entering the coagulating basin is regulated by the demands of the filters, and is controlled by a float-operated butterfly valve in the coagulating basin.

PIPE GALLERY

The pipe gallery is 12 ft. wide, 8 ft. high in the clear, with the floor on the same level as the bottom of the filters, and the piping is so arranged that there are no pipes overhead or on the bottom of the gallery, where they would interfere with walking. There is a clear space in the center of the pipe gallery 6 ft. wide.

The pipe gallery really contains the most important parts of the filter plant, but as a rule pipe galleries are so arranged that they are hard to get at, poorly lighted and ventilated, and are generally avoided as much as possible when the superintendent is showing visitors around the plant. The writer has always insisted that more attention should be paid to this part of a filter plant, and feels well repaid for the efforts that were made in this case to secure a pipe gallery that would be just as accessible as any other part of the plant, and which would not invite neglect on the part of the operators at the plant.



THIS DEVICE, INVOLVING A TILTING TANK AND GALVANIZED FLOATS, REGULATES THE FEED OF COAGULANT IN PROPORTION TO THE FLOW OF WATER

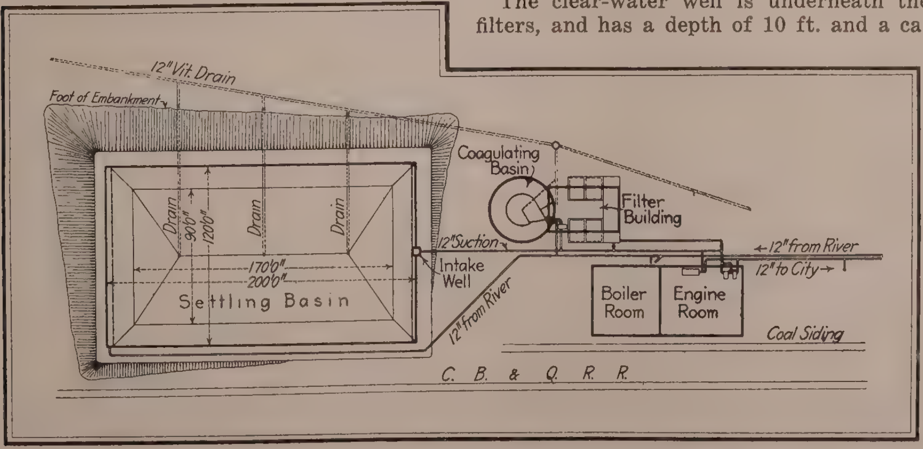
FILTER UNITS

Space is provided for six filter units, each 11 x 14 ft., but only three units have been equipped. As constructed, the weir wall and small compartment usually built in one end of each unit on filters of this size to receive the washwater discharged from the wash troughs were omitted, and the wash troughs were carried the full length of the filter unit. They discharge through special castings set in the front wall of each filter unit and connect to the sewer. This is the first instance in which the writer has used the principle of the draft tube to facilitate the discharge of washwater from the troughs in a filter, but it worked well and has since been used on other plants with equal success.

This form of construction, by which the small compartment at the end of the filter unit was omitted, allowed the capacity of each filter unit to be increased 15 per cent over the usual form of construction without increasing the space required for the filter unit, and the cost of the few extra laterals, strainers, and extra sand was insignificant.

SUPPLEMENTAL COAGULATION

To insure a high bacterial efficiency of the filters soon after washing the writer worked out a plan which is very simple, and which he believes will be widely used when the importance of this matter becomes more generally known. No rapid sand filter will give good bacterial efficiency until sufficient coagulant has been deposited on the sand bed to form a good mat, and if the water as it comes to the filter carries sufficient floc to make a good coating in less than an hour, the period between washings of the filter will be too frequent. Very few operators filter to waste for more than 5 minutes, and as a result most filters are operated in such a manner that the bacterial efficiency for the first hour or two after washing, or at least 10 per cent of the time, is very low, and the much-talked-about "98 per cent removal of bacteria," which is the basis of most filter-plant guarantees, is, after all, a delusion.



WATER FROM THE GREEN RIVER IS PUMPED TO A SETTLING BASIN AND PASSES THENCE THROUGH A CIRCULAR COAGULATING BASIN TO A FILTER PLANT OF THE MECHANICAL TYPE

How many companies furnishing filter equipment would be willing to guarantee 98 per cent removal of all harmful bacteria, if the tests were to be made within 1 hour after the filter was washed, and at the same time guarantee such low percentages of washwater as are now guaranteed?

At the Chillicothe plant a small porcelain-lined tank, holding about 5 gal., is placed on the operating floor beside the alum solution tank. It can be filled to a predetermined level by opening a valve on a pipe leading to the alum tank. Leading from this small tank are three lead pipes, with a valve on each pipe, and these pipes are connected into the raw-water inlet to each filter, so that after a filter is washed the raw water for that particular filter can be given an extra dose of coagulant. This is done while the filter is being filled again after being washed, and the raw water and coagulant are thoroughly mixed as they flow into the filter.

The filter is then allowed to stand for a few minutes, during which time the coagulant forms and settles on the sand bed, thus affording ideal conditions under which to begin filtering with high efficiency. The first water is filtered to waste in the usual manner, except that the water thus wasted does not go to the sewer, but flows back to the large settling basin, and is later filtered over again.

The clear-water well is underneath the filters, and has a depth of 10 ft. and a capacity of 100,000 gal. From this well the water is pumped direct to the city by either of two motor-driven centrifugal pumps, located in the engine room in the electric light plant, and operating under a minimum suction lift of 15 ft.

The discharge from each filter unit is controlled by a rate controller located in the pipe gallery, but with a handwheel connection extending to the operating floor, so that the rate of flow of each filter can, if desired, be regulated by the attendant from the operating floor.

Under all normal conditions the controllers are set for the normal capacity of each filter, and they automatically maintain this capacity until the filter requires washing, or until the clear-water well is nearly filled with water, when they gradually throttle the discharge of their respective filters, but never shut off the flow completely unless the pumps are shut down, in which event the throttling of each filter is so gradual that the flow is not completely stopped for perhaps an hour.

PREVENT FLOODING OF PIPE GALLERY

With these controllers it is impossible to flood the pipe gallery, yet the clear well is always kept well filled with water ready for emergency. In case of fire they can quickly be set to give twice the normal flow, and yet perform all their automatic features.

These controllers operate on the principle of maintaining a constant head of water through a variable orifice, the size of the orifice being regulated by a cone-shaped plug, actuated by a handwheel from the operating floor to change the rate of discharge through the orifice. They have proved to be especially well adapted to the conditions at Chillicothe, where the city uses the direct pressure system, and has several customers who use water in large quantities at irregular periods, for the clear well is always well filled, yet never overflows.

It is the custom in many plants, both large and small, to meet the varying demands for filtered water during the day by shutting down or starting up one or more filter units, and this practice results from the fact that very few filter plants are equipped with controlling devices which will automatically perform this function by varying the rate of all the filters instead of starting or stopping one or more units. Whenever a filter is shut down, even for a very brief interval, small bubbles of air or gas which tend to collect in the sand during filtration will rise to the surface, and in so doing they break the mat which has formed on the sand and when the filter is started again the rate of filtration through these broken places is very rapid, and the bacterial efficiency of the filter is very low.

The writer believes that if a filter is kept in continuous operation from the time it is started until it is washed, that the results therefrom will be much better, even if the rate of filtration is very small at times. It does no harm to change the rate of filtration while the filter is in operation, provided that the change is made slowly.

Air and water are used for washing the filters, the air being supplied through a separate system of pipes so that the flow of washwater can be started before the air is turned off. A novel feature in connection with the air wash is that the air is carried to the different filters through a wrought iron pipe, so arranged as to form a hand-rail around the filters.

All loss of head gages, clear well gages, etc., are of the vacuum type, with mercury columns. All valves are hand-operated, and all valve stands are on line, instead of being spotted all over the operating floor.

The plant was designed and installed under the supervision of the writer as consulting engineer. The mechanical equipment was furnished and installed by the Pittsburgh Filter Manufacturing Company of Pittsburgh, Pa.

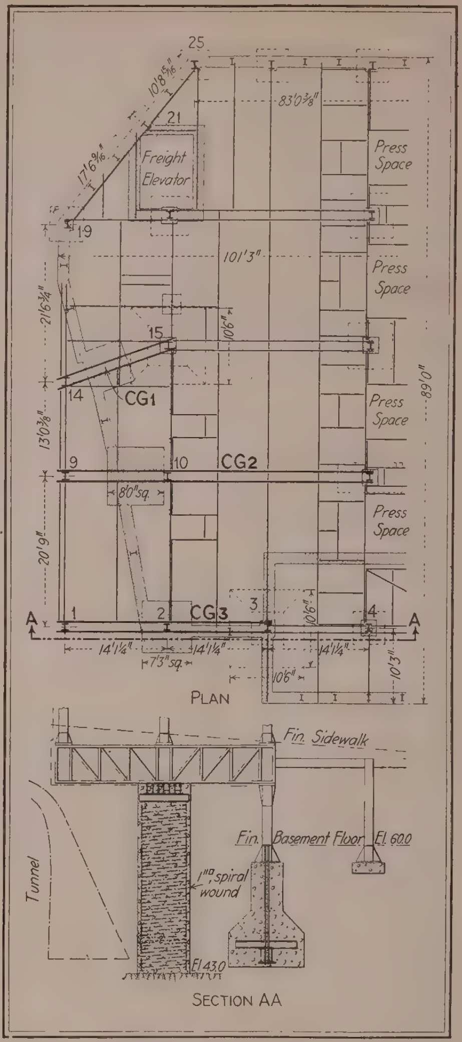
Cantilevers Carry Building Columns Above Tunnel

Foundations of Gazette-Telegraph Building, Pittsburgh, Contain Steel Girders with Diagonal Stiffener Angles

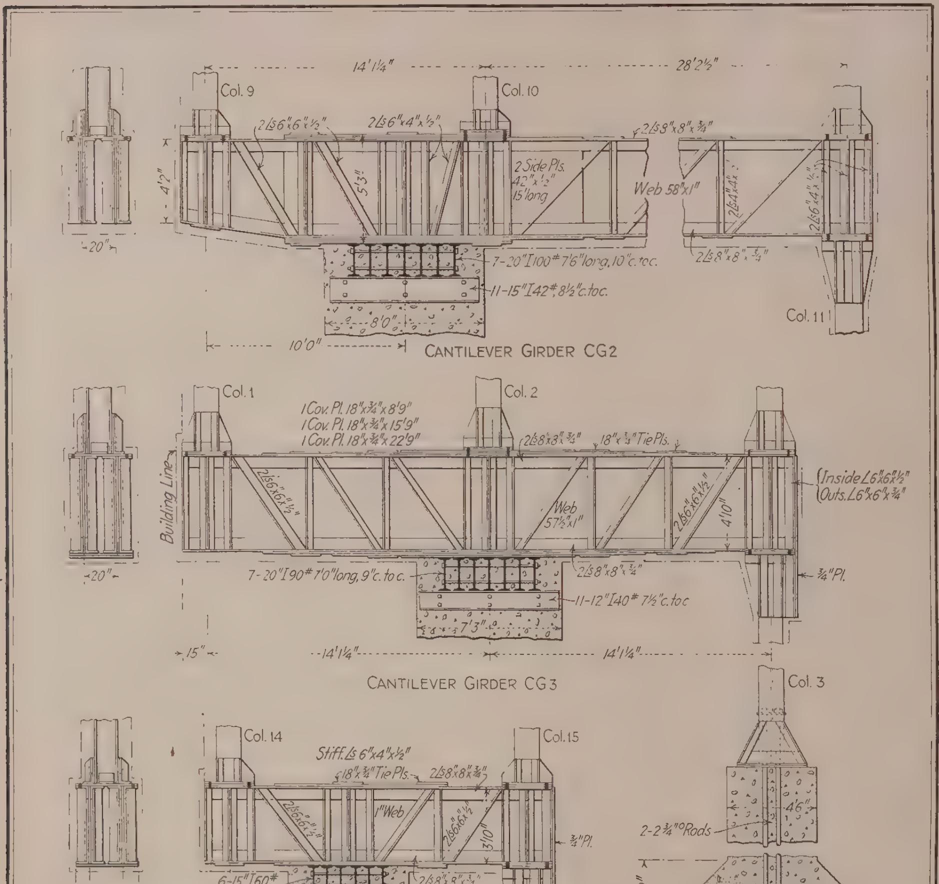
STEEL cantilever girders with diagonal stiffener angles form a special feature in the design of the foundations for the new Gazette-Telegraph Building, Pittsburgh, an eight-story building in course of erection. It was impossible to construct the usual concrete foundations for the columns at one corner of the building, because under this corner passes the large tunnel used by the Panhandle Division of the Pennsylvania Lines West of Pittsburgh. It was therefore necessary to support three outside columns upon cantilever girders. The inner ends carry interior columns, and in two cases are anchored by rods to grillages in the foundation concrete to prevent the possibility of uplift resulting from unbalanced live loadings.

Details of Cantilever Girders

As is indicated on the part plan and section of the basement of the building, three outside columns are carried by double cantilever girders, CG1, CG2 and CG3, the details of which are shown on the other accompanying drawing. Clearance between tunnel and the foundation work of the building was provided by retaining walls of steel and concrete and by the hooped concrete columns, carried down to solid rock, upon which the cantilever girders are supported. The tunnel runs diagonally across the site. The length of the cantilever ends of the girders varies from a maximum of 14 ft. at the corner column to only 6 ft. for the third column along Pentland Street. Diagonal stiffener angles are used to aid in resisting the high diagonal compressive stresses in the webs. The heavy vertical loads are transmitted to the hooped concrete piers by steel I-beam grillages.



PART PLAN AND ELEVATION SHOW LOCATION OF CANTILEVER GIRDERS


Col. 9
Col. 10
Col. 11
Web 58"x1"
2 Side Pls. 42"x½" 15' long
7-20" I 100# 7'6" long, 10" c. to c.
11-15" I 42# 8½" c. to c.
Cantilever Girder CG2
Col. 1
Col. 2
Building Line
Web 57½"x1"
7-20" I 90# 7'0" long, 9" c. to c.
11-12" I 40# 7½" c. to c.
Cantilever Girder CG3
Col. 14
Col. 15
Col. 3
6-15" I 60# 5'6" long 8½" c. to c.
9-12" I 31.5# 8" c. to c.
2-2¾" Rods
12-12" I 28.5# 8'6" long, 9" c. to c.
2-24" I 84# 8'6" long
Cantilever Girder CG1

DETAILS OF CANTILEVER GIRDERS WITH DIAGONAL STIFFENERS—STEEL ANCHORAGE EMBEDDED IN CONCRETE

Interior Columns Anchored

As the difference in total load on the columns at the two ends of the cantilever girders CG1 and CG3 was relatively small, it was decided to anchor the interior columns in each case by the use of two 2¾-in. rods attached to I-beam grillages in the piers under these columns, these piers being carried down for this purpose to sufficient depth to provide the necessary uplift. Any condition of live load on the outer bays unaccompanied by loads on the interior bays would thus be fully provided for. It was unnecessary to anchor the inner end of the cantilever CG2 because of the unequal lengths of the cantilever and anchor arms, the latter being nearly twice as long as the former.

The building was designed for the architects, Lee & Piper, of Pittsburgh, by C. O. Gilbert, engineer. The steelwork was fabricated by the Fort Pitt Bridge Company of Pittsburgh.

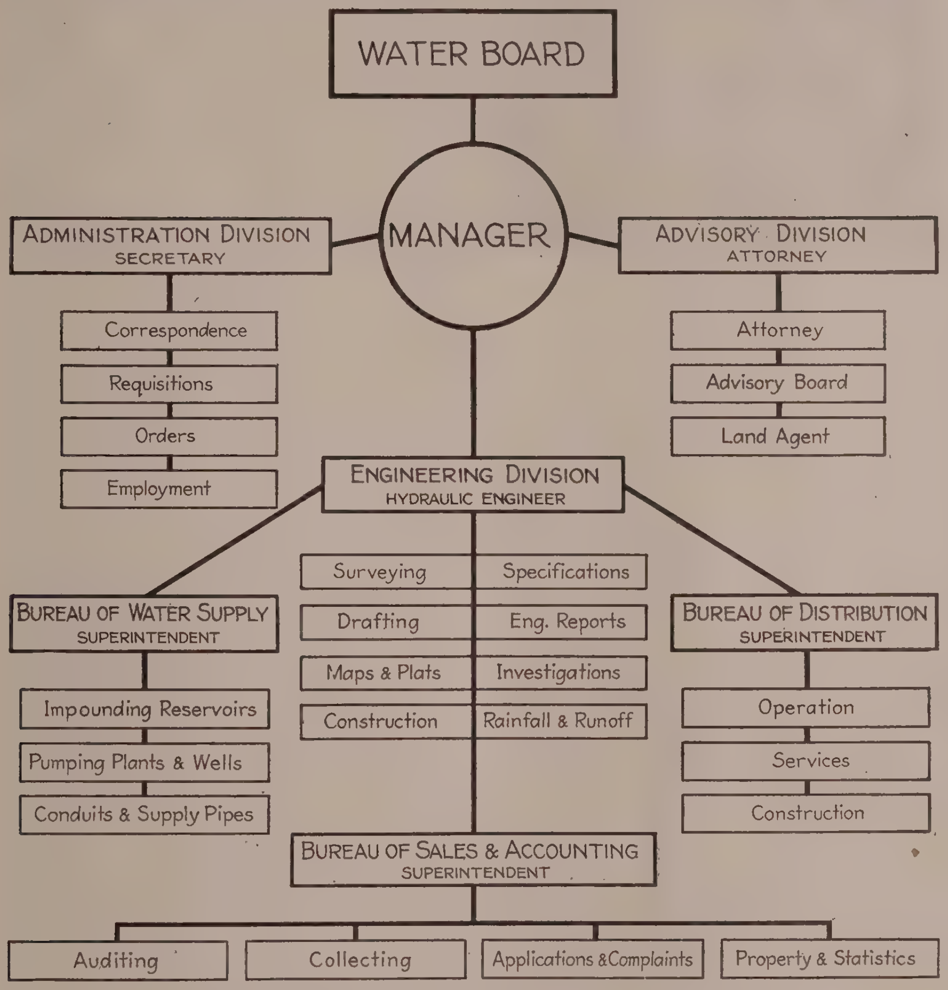
Ideal Organization for Waterworks Described

H. A. Whitney Outlines Scheme for a Department in a City Having 100,000 Population

THE problem of just how to go about organizing a department for handling a newly acquired municipal water system has been faced by many of the rapidly growing cities of the West, and in order to collect some data on the subject and bring out discussion thereon the San Francisco Association of members of the American Society of Civil Engineers assigned this as a paper topic to H. A. Whitney of the hydraulic department of the California Railroad Commission. In his discussion of the subject, from which the following has been taken, Mr. Whitney presented the accompanying diagram to show graphically the general nature and relation of an organization required in a city of 100,000 population.

When the management and operation of a water system come under the control of the city government, provision should first of all be made, said Mr. Whitney, to safeguard from political interference the department which is to handle it. Then to organize the work a governing board, or water board, should be established. This board should consist of three to five citizens, chosen by the mayor and approved by the council, and picked with a view to their breadth of vision and understanding of men. The board should select and appoint a manager for the new department, who must have, in addition to a foreknowledge of such work, resourcefulness in a high degree and initiative and ability.

The water board, according to Mr. Whitney, should hold regular monthly meetings to receive and discuss the report of the manager. In order to facilitate a clear presentation of the status of the work, as well as to control it to better advantage, the manager should arrange to administer the affairs of the department through the three divisions—administration, advisory and engineering—and handle all operating matters through the three bureaus—water supply, sales and accounting, and distribution—as shown in the accompanying diagram. This arrangement is suited particularly to a city of 100,000, Mr. Whitney explained, but the plan may be modified for smaller cities by combining some of the offices and thus reducing the size of staff.



ORGANIZATION DIAGRAM FOR WATER DEPARTMENT IN CITY OF 100,000 POPULATION

Investigate Utilization of Lumber Waste in Wisconsin

The U. S. Forest Products Laboratory at Madison, Wis., according to the National Lumber Manufacturers' Association, is experimenting in converting sawdust and other lumber waste into valuable articles of commerce. The "sawdust laboratory" is working on producing from lumber waste such things as baking powder, artificial silk, binding twine, rope, woven furniture, milk bottles, woven-matting rugs, paper, grain alcohol and several acids. The Forest Products Laboratory is also experimenting in methods of treating wood to make it non-inflammable.

Riparian Rights Settled by Arbitration After Suit

Engineering Board Determines Amount of Damages Sustained by Small Mill Owner Through Loss of Spring Water

By FRANK P. McKIBBEN
Professor of Civil Engineering, Lehigh University

THIS is a case where a mill owner claimed damages because a county, by taking water from a large spring, diminished the water power available for operating his grist mill. The case can be divided into two parts. The first consists of a suit by which the mill owner, in the Court of Common Pleas of Lehigh County, Pennsylvania, established his uninterrupted right to the spring's flow. The second part was an arbitration in which the mill owner claimed and received damages for water taken by the county and in which the amount of damages was fixed by a board of arbitration.

ARBITRATION PROCEEDINGS

Some time after the first suit the mill owner brought another action against the county for damages. Since it was necessary to secure some information regarding the spring, the amount of water consumed by the county and the value of the water power, it was agreed to submit the question to a board of three arbitrators. This board was chosen June 9, 1915, and its report was submitted to the parties concerned July 12, 1915.

The arbitrators determined the capacity of the spring from which the county home is taking water; the amount of water taken from the spring by the county home; the amount of water returned as purified sewage to the stream from the sewage-disposal plant; the loss in water power to which the mill owner is at present subjected, and, finally, the loss in water power to which the mill owner would be subjected and the compensation due him in case the county home were to take all of the flow of the spring and return none of it to the stream.

CAPACITY OF SPRING

Two methods were used for determining the flow of the spring. First, as a small weir had previously been inserted in the overflow of the spring, Ftely and Stearn's formula for the discharge of a weir with a broad crest was applied. This formula is:

$$Q = 2.75bH^{\frac{3}{2}} + 0.007b$$

where Q = discharge in cubic feet per second; b = breadth of weir in feet; H = head on weir in feet. The application of this formula gave a flow of 407,000 gal. per 24 hours. The Francis formula, applicable to weirs with sharp crests, but not suitable in this case, gave 485,000 gal. per 24 hours.

The second method of determining the flow of the spring consists in pumping the water from the reservoir surrounding the spring until the surface of the water is a few inches below the crest of the weir, then by noting the rise in inches of the water in the reservoir, the corresponding time, and by knowing the area of the water surface, the inflow of the spring is determined. This method gave 435,000 gal. per 24 hours.

Taking the average of 407,000 gal. per 24 hours as determined by Ftely and Stearn's formula, and 435,000 gal. per 24 hours as determined by the rise of the water in the spring, the average flow of the spring is found to be 421,000 gal. per 24 hours.

Determining Amount of Water Pumped from Spring

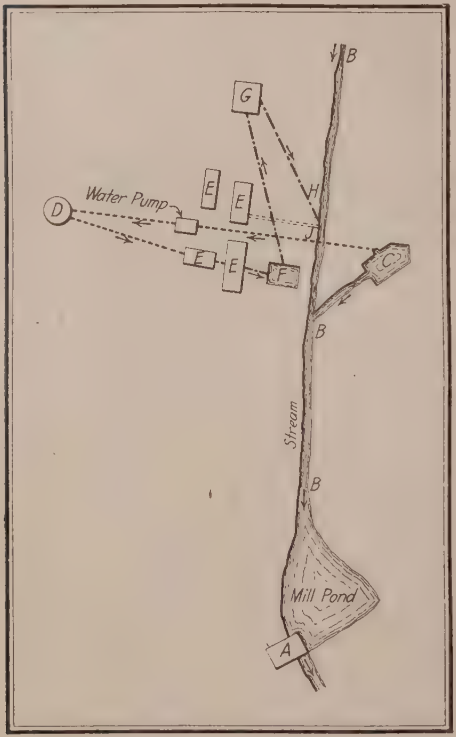
The amount of water pumped from the spring was determined in two ways—first, by computing the discharge from the pump, making a reasonable allowance for slippage, and, second, by determining the amount of water flowing from a tank to the buildings, the elevation of the surface of the water in the tank being determined by direct measurements. By these methods it was found that 84,000 gal. per 24 hours was pumped from the spring and supplied to the institution. Clearly, not all of this water was consumed, because a very large part of it was returned to the stream and, after being purified, reached the mill.

The amount of sewage reaching the sewage well, and thence pumped to the filtration plant, from which it was returned to the stream above the mill, was determined by measurement at the sewage well; and while this could not be determined exactly, the amount of 67,500 gal. per 24 hours is sufficiently accurate.

The total flow of the spring, 421,000 gal. per 24 hours, reduced to power at the mill amounts to 1.3 hp.

Summary of Results

From the foregoing it appears that the flow of the spring is 421,000 gal. per 24 hours; that the amount of water pumped by the county home from the spring is 84,000 gal. per 24 hours, or one-fifth of the spring's daily flow; that of the 84,000 gal. pumped daily from the spring, 67,500 gal. are purified and returned to the stream every 24 hours, leaving a net amount of water removed by the county home of 16,500 gal. per 24 hours, or approximately one-twenty-fifth of the daily flow of the spring; that if the county were to take 421,000 gal. per day, all of the spring's flow, and return none of it to the stream, the mill owner would lose 1.3 hp.



RELATION OF SPRING TO PUMP

A, grist mill; *B*, stream; *C*, spring; *D*, tank; *E*, buildings of the Lehigh County Home; *F*, sewage well; *G*, purification plant; *H*, brook; *I*, concrete conduit, which empties into brook at *J*.

FORMS FOR JOIST AND SLAB FLOOR

The question involved, therefore, is simply this: If the county should take the entire flow of the spring, thus depriving the mill owner of 1.3 hp., what is the cost to the mill owner of producing the equivalent of the 1.3 hp. of which he would be deprived by the county? This loss in water power must needs be made up by the mill owner by means of an auxiliary gas engine operated with producer gas. Taking a unit cost of $55 per horsepower per year, the cost to the mill owner would be $71.50 per year to produce this 1.3 hp. If the county should purchase the right to the entire flow of the spring it should pay the mill owner a sum of money which, if capitalized at 5½ per cent, would produce for him an income of $71.50 per year. Approximately the sum of $1,300 would be required to do this.

The unit cost per horsepower-year of $55 was intended to include the interest on investment, depreciation charges, repairs, insurance, cost of labor and cost of fuel or its equivalent.

Settlement Made

The board of arbitrators therefore recommended that, as the county home will continue to increase in size and will have need for more water as time goes on, the county purchase the right to use and consume the entire flow of the spring, paying the mill owner $1,300 therefor, in return for which the mill owner relinquishes all rights to the spring, thus enabling the county to divert and consume any part or all of the spring's flow, as the county's requirements may demand. A settlement was finally made by the payment of $2,500 to the mill owner.

This case, although involving small values, is of interest not only because it is so typical of many actions based on the law of riparian rights, but also because of the recognition that it is largely an engineering problem.

The arbitration board consisted of Freeman Hawk, Milton U. Reinhard and the writer, all of whom are citizens of Lehigh County.

Slab-and-Beam Floor Without Shear Stirrups

Building for Firestone Tire Company Contains Flared Joists and Shallow Drop Beams of Special Construction—Economy Claimed

By J. H. BYRD
Structural Engineer, Smith, Rea & Lovitt, Kansas City, Mo.

SPECIAL REQUIREMENTS for clear headroom, lighting facilities, appearance, and placing of future partitions led to the adoption of shallow reinforced-concrete joist-and-beam design for the floor of the Firestone Tire & Rubber Company, Kansas City, Mo. The unusual floor details here illustrated include the flared sides for the joists and drop beams at the columns to furnish greater shear resistance and avoid the use of shear stirrups for economy, and heavy T-beams only 15 in. deep carrying the joist loads to the columns. This design is claimed to be more economical than a flat slab designed according to the Chicago building ordinance.

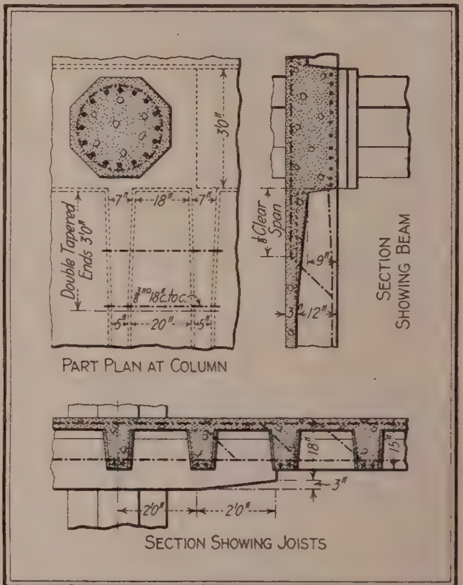
General Features

The building is 74 x 116 ft. in plan, eight stories high, with basement, and a concrete tower 40 ft. above the roof. A clear height from floor to ceiling of 12 ft. was required by the owners. The foundations are caissons built to solid rock 30 ft. below the basement floor.

For various reasons, such as headroom, lighting, appearance, and placing of future partitions, some sort of flat-slab design was desirable; but the required openings for elevators and stairs to a large extent made impracticable the use of the standard flat-slab design. The ceilings for any design had to be suspended metal lath, to hide the steam, sprinkler and plumbing pipes.

Comparative Designs Made

An assumed live load of 200 lb. per square foot was adopted, with 20 per cent deducted for the beam loading and the usual amounts for the columns at the various stories. Several arrangements of beams and slabs were tried for the panels of 24 ft. 6 in. to compare with the adopted design of joists on about 2-ft. centers with shallow end girders as shown in the accom-



DETAILS OF JOIST AND SHALLOW BEAM

panying drawing. All were found to be more expensive, owing to the increased yardage of concrete and the cost of forms for beams.

Features of Adopted Design

A typical wall panel of the adopted beam-and-joist design, including all concrete and steel except the column shaft within the area of 24 ft. 6 in. square, weighs 100 lb. per square foot and contains 0.025 cu. yd. of concrete and 5 lb. of reinforcing bars per square foot of floor area. Comparing this with the flat slab or mushroom system, designed according to the Chicago building ordinance, the slab would be 9½ in. thick with a 4-in. drop panel 10 x 10 ft. at the columns with flared heads. The units per square foot were: Weight, 135 lb.; concrete, 0.034 cu. yd.; reinforcing bars, 4.5 lb.

For the adopted design, the usual bending-moment factors were applied, all joist and beams being considered fixed at the end, and the clear span being used. The joists were tapered or flared at the ends for a length of 36 in., as shown, and no shear stirrups were used. The end beams between the columns were also flared downward to allow the T-beam action gradually to develop without producing excessive horizontal shear.

Design of Shallow Beams

How much T-beam action is developed for these shallow beams is difficult to determine. In this case the flange was assumed to be 108 in. in width at the end of the flared beam, counting 36 in. width of slab tapered as shown on each side of the stem, which is 36 in. wide. The total depth is only 15 in. from the top of the rough concrete to the bottom of the beam.

With these assumptions the factors *kd* and *jd* were obtained and the proper reinforcement provided, the rods being spaced 3 in. apart on centers. For negative moment over the columns sufficient compressive resistance was obtained by the additional depth of the beam and the use of the straight bars in compression. No shear bars were used, the bending up of the main reinforcing providing the necessary shear reinforcement, as shown in the detail drawing.

Test Load Applied

A test load was applied to the third floor on March 27 at the age of 91 days, sand being placed in 1-ft. layers and deflection readings taken after each foot of sand was in place. The loading was thus carried to a depth of 4 ft., or 400 lb. per square foot. The maximum center deflection under this load was 9/32 in. with a permanent deflection of 1/32 in. in one panel only after the load was removed. No shear cracks appeared in joist or beam, water being applied and a magnifying glass used for inspection.

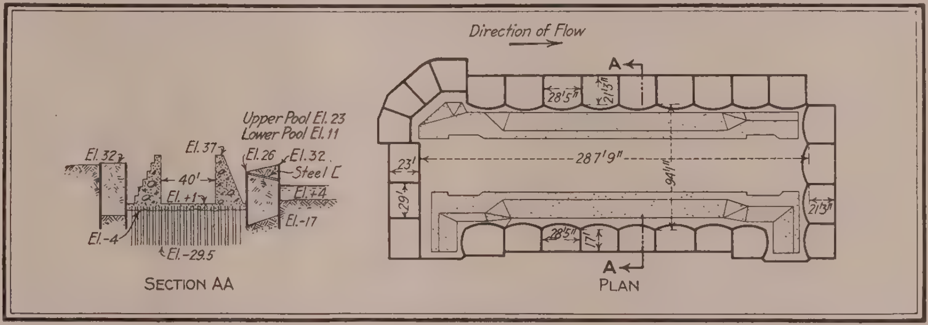
The adopted design was economical in form lumber, on account of the similarity of the floors and the use of 2-in. lumber, securely cleated, for soffits, and 2 x 6-in. pieces for the joist soffits, making all floor forms easily removable, to be used again on the floors above.

Smith, Rea & Lovitt, of Kansas City, Mo., were the architects, and the author, associated with this firm as structural engineer, designed the building. The Swenson Construction Company, of the same city, was the contractor.

Steel Cofferdam of Pocket Type Successful for Lock on Cape Fear River

Horizontal Channel Ties Bolted to Cross-Wall Sheeting Overloaded at One Point—Long Sheeting for Outside, Shorter for Inside Walls

GOVERNMENT lock No. 2 on the Cape Fear River, 72 miles above Wilmington, N. C., has been built inside a steel pocket cofferdam designed to withstand a 30-ft. head. To the web walls of these pockets were bolted steel channels, inclined slightly away from the inside, which were designed to prevent the web-wall piling from leaning by slipping of the interlocks and to make the pockets resist pressure as a unit. These ties failed on one point on the land side, before the coffer was pumped out, by shearing of the bolts, but movement of the wall was successfully stopped by wire-rope anchorages and by relieving the earth and water pressure behind it. A type of land driver with two-way motion, carrying the hammer in a cage in front of the leads, used successfully on the work will be described in a later issue.



INSIDE SHEETING OF RIVER POCKETS LOWER TO ALLOW EASY FILLING

The lock will have a 12-ft. lift. Together with the 8-ft. lift provided by lock No. 1, 39 miles above Wilmington, and the dredging work being carried on by the government, this dam will provide an 8-ft. navigable channel to Fayetteville, N. C., a distance of 115 miles. The entire project, which is nearing completion, will cost about $1,000,000.

Two Types of Pockets Employed

From the accompanying drawing showing the general arrangement of the cofferdam it will be seen that two types of pocket were used. Those at the upper end of the dam had parallel inside and outside walls tied together by steel cables and rods fastened to walings. The other pockets were without ties, the inside wall being curved to reduce distortion in the steel piling from the weight of the fill. Two single-wall panels were required in the upper and lower wings, which were held by cables to wooden pile anchorages. Because of its greater transverse strength, Lackawanna arch-web piling was used in the straight wall pockets and on the outside of the river pockets. The remainder of the sheeting was the straight-web type. The total length of cofferdam was 878 ft.

Profiting by experience gained at the first lock, the top of the steel was carried to an elevation 23.4 ft. above the mean low-water level existing before a pool was created by the completion of the lower dam. This elevation, about 28 ft. above the river bed, provided against all except maximum floods, during which it was not desirable to attempt pumping. As the concrete lock floor was laid before pumping out, the inclosure had a total depth of 31 ft.

For this construction piles 49 ft. in length were required for the outside wall. All the piling in the land wall was of this length, but that used for the side of the river wall next the inclosure was 6 ft. shorter. By sloping the tops of the pockets in this manner the dredge operating inside the inclosure at low-water stages was enabled to fill them much more readily. All of the piles in the inner walls were spliced just above the elevation of the lock floor, the lower sections remaining in place as part of the permanent construction.

The steel for the land wall was driven well back in the river bank where the ground surface was as high as the top of the sheeting. Consequently, these pockets required no filling. The flat on which the tracks for the land drivers was laid was excavated out of the bank. Piles were delivered to the drivers from stock piles by hand cars running on a track in front of the machines. Jets at 75 and 80 lb. pressure were freely used both in the land and the river driving. The penetration of the piles in the land walls varied from 39 to 48 ft. in clay, clay and sand, and marl. Driving to grade was difficult, and in several instances of absolute refusal the tops of the piles were cut off with an oxy-acetylene flame to permit the drivers to proceed. While the land driving was under way, sufficient dredging was done at the upper and lower ends to enable a floating driver to continue the coffer walls out into the river.

As the penetration in the river was only 18 to 21 ft., the two floating drivers were able to place an average of 37½ piles per 16-hour day, as compared to 34½ piles driven by the same single-action steam hammers when used on the land rigs.

The curved panels of the river wall were driven to a template floating on the convex side, which was held in place by adjustable bracing to wood guide piles located inside the cofferdam in line with the cross-walls. The closures of all the pockets were made by the larger steam hammer. Its ram weighed 3000 lb. as compared with 1800 lb. for the other hammer. It was found difficult to keep the piling vertical, as a leaning tendency frequently developed in the direction of driving. In four instances, especially fabricated, wedge-shaped

LAND WALL COMPLETED AND TWO DRIVERS AT WORK ON RIVER POCKETS

piles had to be used for making a closure. All of the pockets were closed on the outside wall. Driving was carried on alternately on the rear and cross-walls of a pocket until only the four piles nearest a corner remained. These last four piles were then entered at once and driven successively a few feet at a time to grade.

DIAGONAL WALES FAIL IN FOUR POCKETS

Diagonal steel channel walings were bolted to all the cross-walls. The holes for the bolts were burned in the piling after driving with an oxyacetylene flame. These wales were designed to prevent the sliding of one interlock on another, due to the overturning moment on the pockets. In this they were successful except at four of the pockets near the upstream end of the land wall. Although the earth back of these pockets had not been disturbed in any way and was not surcharged, as dredging proceeded in front of them they began to lean toward the excavation. The maximum movement at the top amounted to 7 ft. 6 in., and an examination of the walings on the cross-walls of these pockets showed that all of the fastening bolts had sheared off. As it was not practicable to put enough bolts in the waling to withstand the stress, the pressure was partly relieved by excavation and drainage of the soil back of the pockets, and further movement prevented by anchoring them to trees by means of heavy wire cables. This solution of the difficulty proved satisfactory, and no further movement was detected even when the cofferdam was pumped out. At the lower end of the land wall no similar movement occurred, although there were 2500 wooden piles stacked immediately back of the steel at this point.

A gap was left at the lower end of the cofferdam for the passage of the dredge and a floating driver. The inclosure was excavated by the U. S. engineer dredge "Ajax" with a 5-yd. clamshell bucket. About half of the sand and clay removed was used to fill the pockets of the cofferdam at an average cost of 26½ cents per cubic yard. However, considerable material next the steel sheeting could not be touched by this bucket, and had to be loosened by jetting and removed with a ½-yd. orange-peel bucket. A small shelf of marl encountered in the lower wing also required some blasting. Further, the shoaling of the bottom during pile driving exceeded expectations, and additional dredging by siphon in a considerable area where piles had been driven was necessary. These operations increased the total unit cost of the material removed to 46½ cents per yard.

After all the foundation piles had been driven with the floating drivers, the gap left at the lower end of the cofferdam was closed and the bottom sealed with a 5-ft. layer of concrete deposited through a tremie. After this concrete had set a month, the cofferdam was unwatered with a 12-in. centrifugal pump mounted on a raft. After the raft had grounded, unwatering was finished with a 10-in. submerged centrifugal pump. The pumping was purposely extended over two days in order to watch the behavior of the cofferdam walls. The only movement detected, however, was the slight inclination of the river wall, which brought its top 1½ in. in toward the lock pit. The maximum head under which work was carried on in the cofferdam was 26 ft., and leakage at ordinary stages of the river amounted to about 200 gal. per minute. A 24-in. pipe through one of the pockets 12 ft. below the top of the dam was provided for flooding. It was fitted with a gate valve.

POCKETS AT UPPER END OF LEFT WALL LEANED DURING DREDGING

COSTS FOR DRIVING SUMMARIZED

The unit costs of the different operations in constructing the cofferdam are summarized in the accompanying table. They include payroll, supplies and a charge for repairs to the plant employed.

COST OF DRIVING STEEL SHEETING

	Per Pile	Per Ton	Per Lin. Ft.
Driving land piling	$5.18	$5.77	....
Driving river piling	2.28	2.53	....
Driving piling, average	3.36	3.75	....
Splicing piles	.47	....	....
Handling piles	.30	....	....
Placing wales	....	....	$0.79
Driving wood anchor piles	4.57	....	....

In addition, it cost $29.45 each to install the tie cables. As 17.7 per cent of the total tonnage of steel in the cofferdam became a part of the permanent structure, the cost of driving chargeable to the cofferdam given above should be reduced by this amount.

The construction work was carried on by government forces with government plant under the general supervision of Capt. C. S. Ridley, Corps of Engineers, U. S. Army. Norman M. Chivers was assistant engineer in charge of the work at lock No 2.

Railroads Burn 24 Per Cent of Coal

Figures given out recently by the U. S. Geological Survey show that the railroads of the United States last year consumed 24 per cent of the country's total coal production. Practically all of the 600,000 tons of anthracite and 62,700,000 tons of the 128,200,000 tons of soft coal consumed by railroads were burned in the Eastern district. Railroads of the Western district burned 43,500,000 tons, and those of the Southern district 22,000,000 tons.

Reinforced-Concrete Arch Has Masonry Facing

Eagle Creek Spanned Near Portland, Ore., by Structure in Harmony with Surroundings —Details for Tying Masonry to Concrete

ARCHED STONE HANDRAIL AND RUBBLE FACING IMPROVE APPEARANCE OF ARCH BRIDGE

A COMBINATION arch bridge of reinforced-concrete ribs with spandrel columns and a rubble-masonry facing and abutment walls was found more economical than an all-stone arch at the given site for an ornamental structure crossing Eagle Creek in the Northwest. The design and the details used to tie the face wall of masonry to the concrete ribs and columns illustrated herewith indicate an effective solution of a common problem.

The Eagle Creek bridge in Multnomah County near Portland, Ore., consists of a 60-ft. semicircular arch span of three concrete ribs, the foundations of which are cemented gravel. The 20-ft. roadway is carried on spandrel columns carrying beams of 10-ft. spans. A 12-in. random rubble wall set in cement mortar carried on a stone arch ring conceals the concrete work, producing the effect of a stone arch bridge. The curved abutment walls are of dry masonry, having a face batter of 1:4.

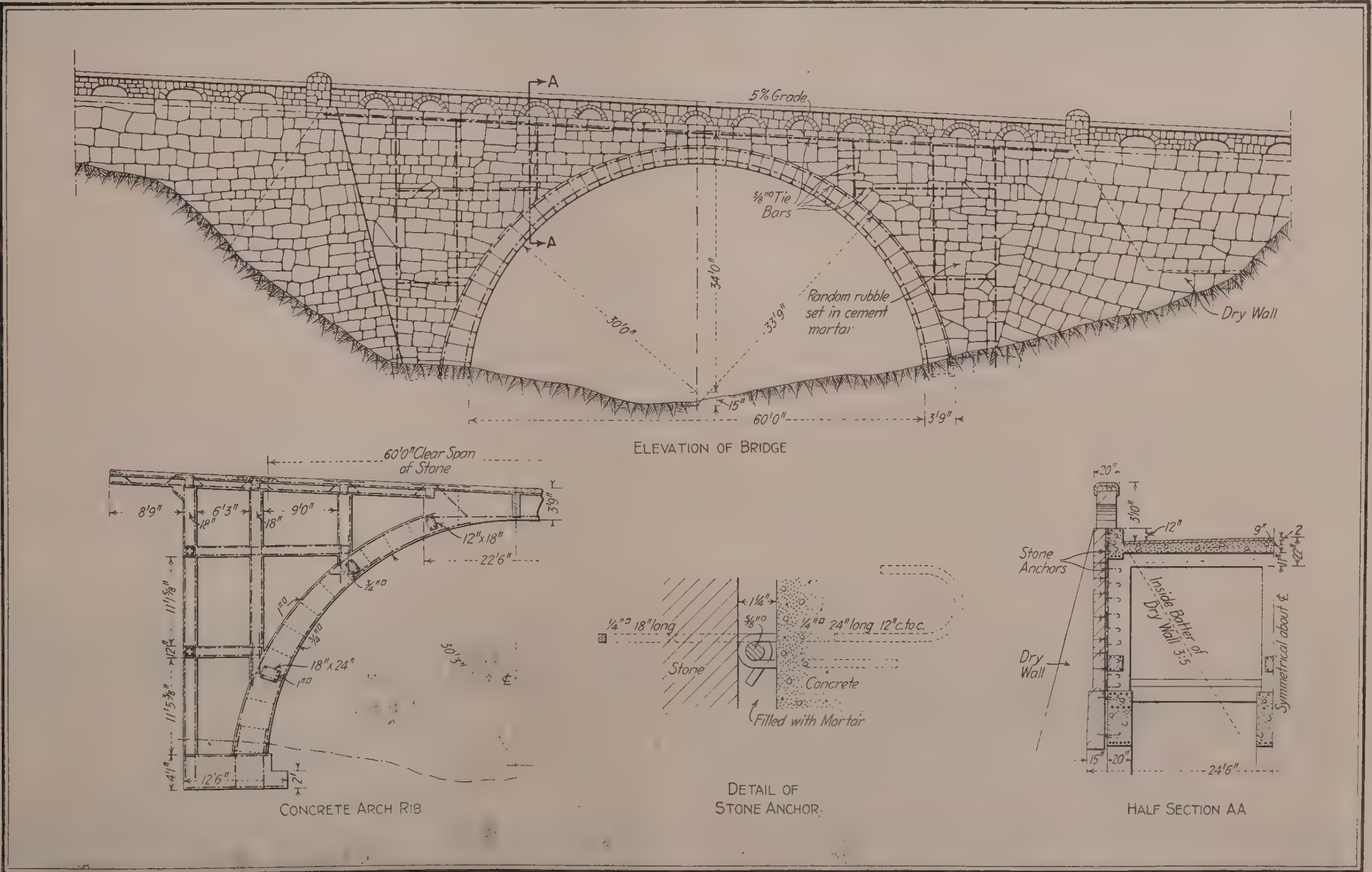
MASONRY TIED TO ARCH RINGS

The masonry arch rings were tied to the outside concrete rib, spandrel columns and struts by means of hooks of ¼-in. square deformed bars, buried in the mortar joints. Steel rods ⅜ in. square were embedded in the concrete rib, allowing a loop to extend beyond the face of rib. Through these loops ⅝-in. round bars were threaded. The masonry bars were hooked around the ⅝-in. round rod and buried in the masonry joints, as indicated on the detail in the drawing. By the same method the masonry spandrel walls were attached to the concrete spandrel columns and struts. A 1¼-in. space was left between the concrete rib and spandrel wall, to be filled with mortar as the work progressed.

DESIGN OF ARCH RING

The stone arch ring was designed as carrying the weight of the stone spandrel wall. The entire live load was assumed to be carried by the concrete structure. The bridge is designed to carry two 20-ton trucks in line, with an impact added of $L^2/2\ (L + D)$, where L and D are the dead and the live load respectively.

The combination of concrete and stone was found more economical than a stone arch, owing to the high cost of suitable rock at the bridge site. The cost of the bridge complete was $10,000. It was designed under the direction of C. H. Purcell, bridge engineer. The structure was built by county forces. Herbert Nunn was county highway engineer and J. B. Yeon roadmaster.



SECTIONS AND ELEVATION OF REINFORCED-CONCRETE ARCH WITH SPANDREL COLUMNS—DETAILS OF CONNECTIONS TO MASONRY FACING

Construct Dams by Hydraulic Method with Minimum of Cost, Labor and Equipment

Mine Tailings Stored in Arizona Behind Dams Built of the Same Material After Separating Heavier from Lighter by Flume Perforations

By CYRIL WIGMORE

ARIZONA law requires that tailings from mills shall not be allowed to enter running streams which might convey them to agricultural lands in the valleys below. For this reason mining companies have been obliged to find some means of impounding the great quantities of tailings which the mills produce and which would ordinarily be carried by drainage or mill-sluicing waters down the steep slopes and into the streams. This has resulted in the construction of dams by a hydraulic process with a minimum of cost, labor and equipment.

Mill 6 of the Arizona Copper Company is situated near Morenci, at an elevation of 5000 ft. It originally had a capacity of 2000 tons per day, which has since been increased to 3500 tons. After the ore is crushed it is passed in its final state through 1½-mm. screens, resulting in a product of which 40 per cent passes a 200-mesh screen. The average production of tailings from this mill amounts to about 1500 tons per day, and the disposition of this waste product has been the subject of careful study on the part of engineers retained by the company.

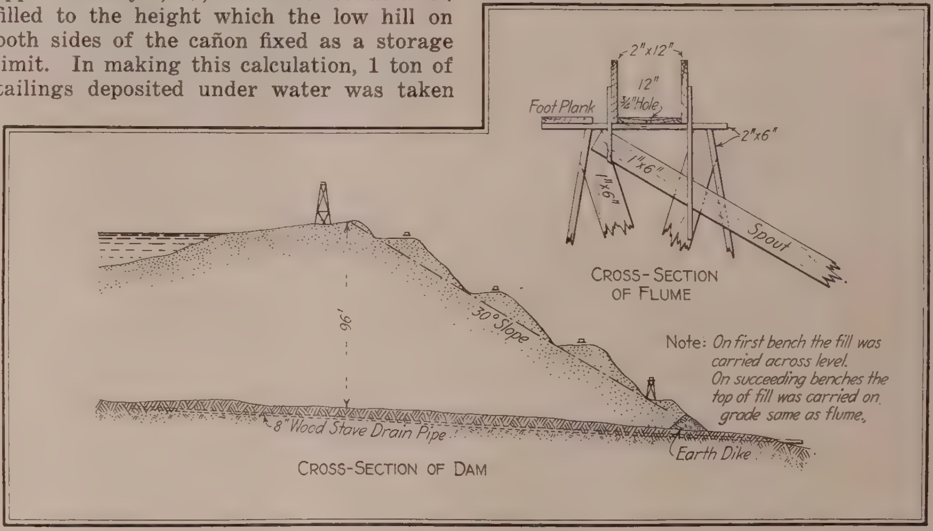
SUFFICIENT STORAGE NOT AVAILABLE

This mill is so situated that storage of sufficient extent is not available in the narrow cañon immediately below it, the nearest suitable location being about 3½ miles below where the general contour of the hills flattens to sloping mesas with a broad main cañon and several tributaries of slight grade and considerable breadth. On account of the floods during the rainy season the main cañon was considered a difficult place to impound tailings. However, the first storage for tailings was provided by a dam constructed across the main cañon about 1200 ft. in length and equipped with a timber wasteway and tunnel for the purpose of carrying off the settled waters and the runoff from the drainage basin located above.

This dam was an earthfill built up with scrapers and provided with a hydraulic-fill core. The height was approximately 50 ft. and the basin back of it was completely filled with tailings, about 250,000 tons being impounded. The cost of placing the earthfill with teams and scrapers, however, was excessive and figured out to be approximately 6 cents per ton of tailings impounded. It was, therefore, deemed necessary to devise some other, less expensive, scheme for disposing of the tailings.

PLANNING THE TAILINGS DAM

After a series of experiments carried on in 1907 and 1908 a plan was devised for using the coarse sandy portion of the tailings to build up a hydraulic-fill dam, while the finer material was held back from the face of the dam itself for a considerable distance upstream. A site was selected in one of the branch cañons which would hold approximately 6,000,000 tons of solids when filled to the height which the low hill on both sides of the cañon fixed as a storage limit. In making this calculation, 1 ton of tailings deposited under water was taken as the equivalent of approximately 20 cu. ft. in volume.



CROSS-SECTIONS OF DAM AND FLUME, LATTER SHOWING DISCHARGE HOLE AND SPOUT

At the site selected for the dam an 8-in. wood-stave pipe was laid along the axis of the cañon from a point below the downstream toe, extending upstream approximately 4000 ft. At intervals of 300 or 400 ft. in this pipe tees were placed with a nipple, elbow and length of pipe standing vertically, the nipple fitting loosely in the tee so that the pipe could be swung in a vertical arc. By this means the entrance to the pipe could be kept at the reservoir level and would draw off only the clear surface water. At the lower end of this pipe line, below the toe of the dam, pumps were installed which returned the clear water to the mill to be used over again.

The surface of the ground at the dam site consisted of soil and detritus carried down from the mountains. Nothing was done to prepare the surface for the dam except to scrape up a dike about 6 ft. high along the downstream toe. This dike was to prevent tailings from washing away until the scheme of construction could be put into effect. The flume itself was set back about 20 ft. from this dike.

FIRST INSTALLATION

The first installation at the dam site consisted of a 10 x 12-in. flume made of 2 x 12-in. plank supported on bents 12 ft. apart. The bents were constructed of 2 x 6-in. lumber with legs supported on small footboards and with 1 x 6-in. diagonal bracing. The flume was approximately 1000 ft. in length and was built on a 2 per cent grade, which made the center bent of the flume about 24 ft. in height.

In the bottom of the flume ¾-in. holes were bored every 4 ft. and beneath these were fastened short troughs or spouts made of two pieces of 1 x 6-in. lumber 6 to 8 ft. in length. These spouts pointed down the cañon and were given a pitch from the horizontal of from 30 to 60 deg., which was varied as required. The coarse sands, being heavier than the finer material carried in suspension, traveled along the bottom of the flume and poured through the small holes in steady streams without permitting the escape of much water. This coarse material rapidly piled up beneath the spouts, and from these piles it was shoveled up by hand in a continuation of the dike which at first marked the downstream toe of the fill.

The percentage of coarse sand carried determined the number of small holes that would be kept open. If this percentage were low, only a short section of the flume was used, the remaining holes being

SPOUTS IN SERVICE ON 1000-FOOT FLUME

GENERAL VIEW OF ONE OF THE MINE-TAILING DAMS plugged. In short, the number of holes opened was that number which would be provided with a steady flow of sand by the grade of material being handled. In order to increase the height of the dam uniformly throughout its length, successive sections of the flume were used in rotation.

At first small pipes about 3 in. in diameter were placed through the earth dike to carry off the excess water and prevent the washing away of the material, but the hydraulic fill was found to build up very rapidly, and by keeping the dike a foot or two higher than the depositing material the fill was found to assume a grade of about 7 per cent on the upstream side. This flat slope resulted from the incoming water and fine material impounded behind the coarse fill. It is notable that the water drained from the coarser material with great rapidity, and it was possible to walk over it almost immediately. In a few hours there was no water visible in the higher portions of the slope. It was observed that the fill settled very slightly on account of the solidity with which the material packed down as it fell from the flume. The filling of the cañon required the use of three dams, all of which were built in the same manner.

Construction Force and Methods

One laborer per 8-hour shift was found to be enough to keep the dike shoveled up along the crest of the downstream slope. It was intended to keep the incline of this slope at about 30 deg., but it was found that the sand shoveled up by hand assumed a slope of about 45 deg., and this was allowed to govern. The fill was continued on each stage until the material reached the bottom of the flume and necessitated its removal to a new position. When the flume was moved it was set back upstream a sufficient distance to bring the general slope of the downstream face to about 30 deg., as shown in the accompanying drawing. In moving the flume, bents which could be easily pulled were taken out and used again, the others being abandoned. It was found that the loss of lumber involved was very slight.

Four men were normally required in the construction of the dam. One man on each of the three 8-hour shifts watched the flume, attended to the plugs in its bottom, and shoveled up the dike or border, while a fourth man acted as foreman and had general charge of the operations. The moving of the flume necessitated by the completion of each stage in the building of the dam occurred at intervals of about 90 days—these intervals varying with the tonnage impounded and the increasing length of the dam, the interval being longer as the length of the structure increased. Flood waters were carried off through a tunnel driven through a hill on the west side of the basin. A 6 x 6-ft. timber waste tower was built at the entrance to this tunnel, and the height of this tower was increased from time to time as the work advanced.

Material Handled at 1 Cent a Ton

At the time the photographs were taken the dam was 1800 ft. in length and 96 ft. in height. The cost of handling the material used in its construction while placing 1500 tons per day has amounted to approximately one cent per ton, not including the cost of the water. The water, however, had formerly been lost when the tailings were allowed to settle and distribute along the cañon and empty into the rivers previous to the enactment of the law that prohibited this practice. Now that the water is saved it is considered that its value should be credited to the impounding system.

It has been suggested that where water is available this system of deposition in a modified form might be used to advantage in the construction of railroad or highway fills or earthfill dams, since it does not require an expensive outfit and the work can be carried on with a small crew over an extended period. It is said to be applicable wherever sandy earth, sand or material not carrying any considerable percentage of rock and gravel is available, as under these conditions the cost of hydraulicking is low and only light grades are required to transport the material, which keeps the necessary volume of water down to a minimum.

These dams were constructed according to the design and under the supervision of the author, who also built the earthfill dam first used for storing tailings from this mill.

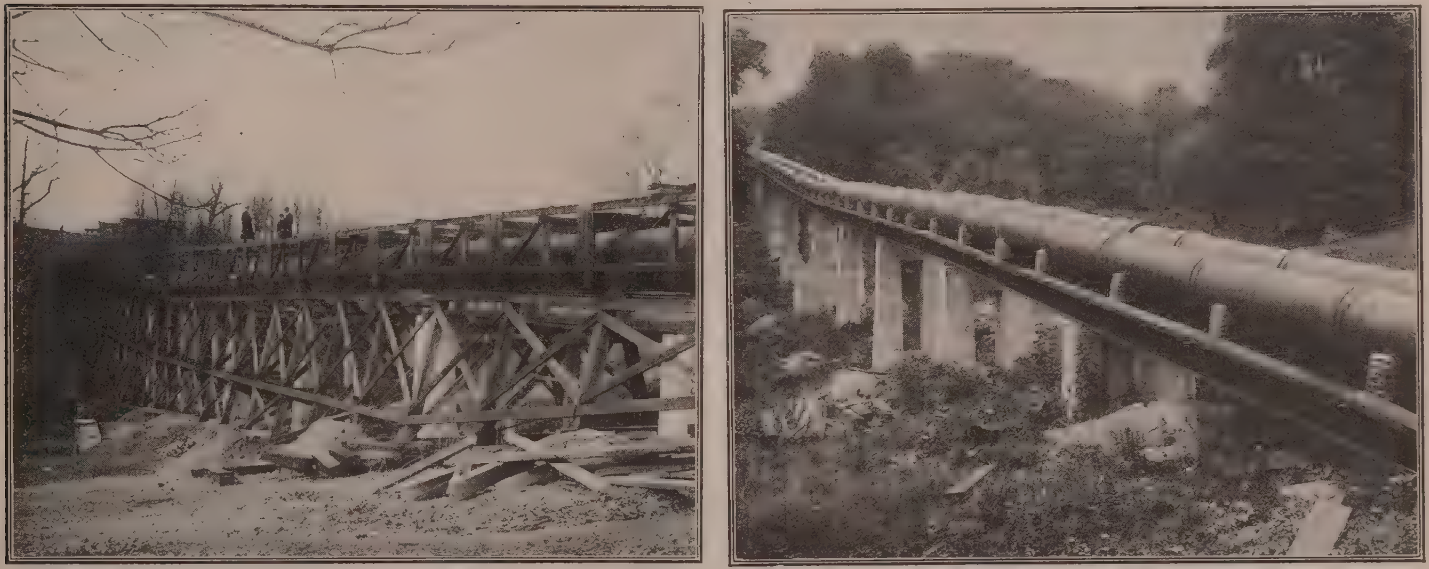
Pipe Trestles of Wood Replaced by Concrete

Permanent Structures Supersede Decayed Wooden Supports at Philadelphia Without Interrupting Water Service

By JOHN S. ELY

Assistant Engineer, Bureau of Water, Philadelphia

THE Water Bureau of Philadelphia has recently completed the replacement of several old wooden trestles carrying large feed mains with new structures of concrete and steel without interrupting the service of the feed mains. The largest of these, known as the Silverwood Street trestle in Roxboro, is 432 ft. long, 27 ft. high at the center and carries two 30-in. mains. Another, known as the Fowler Street trestle, is 144 ft. long and 12 ft. high at the center, and carries the same two mains, being about 1 mile north of the Silverwood Street structure. A third and fourth are at Devereaux Street and the Northeast Boulevard, one carrying a 48-in. main and being 180 ft. long and 14 ft. high; the other carrying a 30-in. main and being 396 ft. long and 20 ft. high.



MAINTENANCE OF WATER SUPPLY REQUIRED THAT THE LARGE MAINS BE KEPT IN UNINTERRUPTED SERVICE WHILE THE DECAYED WOODEN TRESTLES WERE BEING REPLACED WITH CONCRETE AND STEEL SUPPORTS

Old Trestles Decayed

The wooden trestles replaced were from fifteen to twenty years old, and for some time had required almost constant repair. They were all of the same general type of construction, as shown in the photograph. Although portions of the timber were quite sound, other parts, especially the mud sills and some of the uprights, were badly decayed.

The maintenance of the water supply required that these feed mains should be kept in uninterrupted service, and it was therefore necessary to design structures which could be built without materially disturbing the old trestles. This was accomplished by spacing the concrete piers half way between every third bent of the old trestle, these piers being 36 ft. apart center to center. The concrete piers carry 24-in. I-beams 36 ft. long, the elevation of these beams being such as to bring their tops just below the old wooden caps so that the latter might be temporarily left in place. It was then an easy matter to transfer the load to the new structure and remove the old.

The execution of the work required considerable care on account of the condition of the old trestles. This was especially the case on the Silverwood Street structure, where it was necessary to carry some of the pier foundations to a considerable depth through quicksand before suitable footings could be found, and there was constant danger of undermining the old trestle bents.

The structures cost about as follows:

Silverwood Street trestle	$6,800
Fowler Street trestle	1,700
Devereaux Street trestle (48-in.)	2,000
Devereaux Street trestle (30-in.)	3,700

The work was done under the general supervision of Carleton E. Davis, chief of the Bureau of Water, by H. M. Platt, contractor, of Philadelphia.

Bronze-on-Bronze Friction in Sluice Gates Tested

Results on U. S. Reclamation Structures Show Wide Variation in Value of Coefficient

By D. C. HENNY

Consulting Hydraulic Engineer, Portland, Ore.

IN THE DESIGN of the moving apparatus of large sluice gates intended to operate under high pressures, the friction of bronze on bronze is the most important factor. Much difference of opinion exists as to the proper coefficient to be adopted in design.

The U. S. Reclamation Service has installed in the last few years sluice gates at the Pathfinder, Arrowrock and Elephant Butte dams. These gates are provided with bronze wearing faces and are operated by oil pressure on pistons moving in cylinders mounted on the gate bodies. Experiments have been made during the last year to ascertain the coefficient of friction. The operating force was determined from reading of the oil gages. Internal friction of moving apparatus was approximated by the oil pressure necessary to move the gate near its wide-open position. The weight of moving parts was known and allowed for. The gates were moved so slowly that the force required to overcome momentum could be neglected.

Pressures were read and frictional resistances were determined for the gates in various positions. Considerable variation was found in the resultant friction coefficient, the maximum exceeding the average over 30 per cent. The maximum values found for the gates nearly or entirely closed are given in the accompanying table:

Results of Friction Coefficient Tests on Sluice Gates

	Size of gates				
	Horizontal, ft.	Vertical, ft.	Pressure, ft.	Maximum friction coefficient	Experiments under supervision of
Pathfinder	4.42 x	7.50	127	0.44	A. Weiss
Arrowrock	5.00 x	5.00	48.5–54.8	0.42	C. H. Paul
Elephant Butte	3.92 x	5.00	109.8	0.38	L. J. Charles

With a few exceptions materially smaller factors were found with the gates partly open, which is probably due to vibration.

The gates tested had been raised and lowered previous to the experiment at intervals of not over two months. The effect of leaving gates closed for many months or years cannot well be determined, as Reclamation instructions require gates to be operated periodically to ascertain their working condition.

Letters to the Editor

Comment on matters of interest to engineers and contractors will be welcomed

Stream Flow, Not Rainfall, Best Criterion for Yield?

Sir: The writer was much surprised by some of the statements of Clemens Herschel in regard to rainfall and stream flow as quoted by you in the issue of July 22, 1916. Mr. Herschel evidently ridicules the idea of the usefulness of rainfall data and would have all the estimates on the power available at prospective water-power sites based on the contents of a single volume, in which all the data contained in the water-supply and irrigation papers would be summarized in 400 single-page cuts.

Mr. Herschel states that "if the daily discharge of a river at a certain point be plotted for the 365 days of the year, in order of their magnitude (not consecutively in the order of the days of their occurrence), a perfectly smooth curve showing the year's discharge will be produced. Take fifteen or twenty such years, if the records avail, and three such curves may be produced—one of average flow, another enveloping all the minima flows, and a third enveloping the maxima flows. And for a period of that length the discharge of that river, at that point, has been portrayed practically for all time. Nothing, or little more, is needed in its hydrographic study for the uses of the constructing engineer."

While it would indeed be fortunate if records of from fifteen to twenty years in length were available over the entire country, as a matter of fact there are comparatively few records of such length as this unless it be in New England, where water powers have been in existence for three-quarters of a century. We may take, for example, the thickly populated state of New York, where stream gaging has been carried on to a much greater extent than in most states of the Union. In all of that part of the state in which the rivers drain ultimately into the St. Lawrence, comprising rivers important for water-power purposes—such as the Genesee, Oswego, Salmon, Black, Racquette, Saranac and Ausable—there is not a single fifteen-year record.

Such curves as Mr. Herschel proposes must be taken, almost altogether, from records from one to ten years in length. For an engineer to make estimates on such data without due consideration to the records of rainfall for 40 or 50 years, which are in most cases available, would be absurd.

While it is futile to attempt to formulate the relations between rainfall and runoff, at the same time the amount of runoff is more dependent upon the amount of the precipitation and its variations throughout the year than upon any other factor. While there is no question as to the value of stream-flow records, the study of rainfall data in connection with them will continue to be of the utmost importance, at least for the next twenty-five years, until we have a much greater number of long stream-flow records.

Mr. Herschel deprecates the usefulness of the data contained in the water-supply and irrigation papers on the ground that too much data are given. Sufficient data are given to enable those who use the results to appreciate their accuracy, and the U. S. Geological Survey is to be commended for this practice.

Many of the water-power failures of the country have been due more than anything else to overestimating the power available. Estimates have been made based on short stream-flow records without due consideration to the rainfall. Mr. Herschel's plan of combining all the stream-flow data of the country into one volume would undoubtedly furnish an easy way for those who do not care to take the time to give thorough study to the problem to make rough estimates. However, if the material in such a volume were used without consideration to the manner in which the measurements were made and to the long rainfall records available it would do more harm than good.

James P. Wells,
Consulting Engineer.

Rochester, N. Y.

His Work Done

Sir: It has been repeatedly remarked in your pages of late that engineers, who are in a large measure responsible for the success of many of the most notable enterprises, fail to get adequate appreciation of the essential part they are playing in the world's development. This is undoubtedly true, and I am therefore happy to be able to bring to your attention an exception, which I am confident must have created a profound impression in the minds of those members of our profession who were fortunate enough to witness the occurrence.

Coos Bay has been many years awaiting the construction of a railway to provide direct connection with the interior, and is celebrating its completion at the time of this writing. One of the features of the celebration was the dedication to the city of North Bend, Ore., of a magnificent natural park of virgin timber, overlooking the bay, and the bridge carrying the Southern Pacific Railway across Coos Bay to the cities of North Bend and Marshfield. A vast throng of people, including representative organizations from Portland, San Francisco and other nearby cities, had gathered in the twilight of a beautful evening, in a natural amphitheater surrounded by giant fir trees, to witness the dedication and to listen to the addresses of Oregon's governor and many other notable men who had come to congratulate Coos Bay. When L. J. Simpson, the donor of the park, reviewed the events that had led up to its dedication, and paid tribute to the men who are leaders in the development of Coos Bay, he asked for recognition of the work done by the man—the engineer—who built the bridges spanning the Coos Bay Harbor and the

Umpqua River on the just-completed branch of the Southern Pacific Railway.

He related how this engineer—crippled for life through the loss of a leg in a collision between his gasoline speeder and a work train—on his bed in the hospital at North Bend had heard the joyous sound of the factory whistles around the bay, welcoming the first through train to pass over his completed bridges, and the salute of the locomotive in reply. He burst into tears and exclaimed, "Thank God, my work is done!" The large spirit of the 3000 Oregonians and Californians, gathered in the mighty solemnity of that virgin forest, responded in an outburst of thundering applause for C. R. Broughton, an engineer.

L. F. HEUPERMAN,
Marshfield, Ore. City Engineer.

Justice to the Contractor

SIR: I have read with interest the editorial, "Justice to the Contractor," appearing in your issue of April 15, page 502, and believe that there is much merit in what you advocate. However, it would seem that the issue is still somewhat confused. Friction between engineers and contractors arises from a number of causes, of which the following are possibly the most conspicuous:

1. Low bidding, with the resulting tendency of contractors to skimp their work in order to avoid serious financial losses.
2. Careless or crooked superintendents. No contractor of importance can personally supervise all of his projects, and the men whom he selects are naturally more anxious to show profits than they are to follow the specifications.
3. Incompetent contractors and superintendents—men who, though paid a fair price for their work, are constantly in trouble with the engineer because they do not know the difference between good methods and bad methods, and greatly dislike interference on the part of any engineer.
4. Incompetent or unscrupulous engineers.
5. Cloudy or unjust specifications.

The writer has been engaged on government work now for about ten years and, like most engineers, has had his share of trouble with contractors, and it is his candid opinion that at least 90 per cent of the friction between engineers and contractors comes under the first three heads mentioned. The average contractor makes two erroneous assumptions—first, that he is always entitled to profit; and, second, that the party of the first part in his contract has no interest except in the general quality of the finished structure.

The first assumption leads contractors to try to filch a profit when they have underbid on a job. The second assumption is a frequent cause for the underbidding, for instead of bidding on methods and even materials that are definitely described in the specifications, contractors often bid on something that they may honestly enough suppose to be just as good, but which, nevertheless, does not conform with the specifications. Thus, not long ago the writer had charge of a concrete bridge job the specifications for which definitely forbade the use of the sand and gravel found in the river over which this bridge was to be built. The only other sand and gravel available had to be hauled nearly 10 miles. The man who got the contract claimed that the clause forbidding the use of the local river gravel was unjust. A serious conflict resulted. It was evident that the contractor had examined the local material before he put in his bid, and that he thought it probable that he could "bluff the engineer out."

Another case which the writer recently had to handle involved the use of brass-plated hardware on a contract calling for solid cast bronze hardware. The contractor said frankly that he had bid on the cheaper hardware, that he thought it was really just as good, and that he felt it was an imposition to ask him to go to the expense of following a specification that he believed to be unnecessary. Of course there was some friction, for the change cost the contractor a good deal of money.

It is true that engineers are sometimes crooked and, I suppose, often incompetent. But is there any reason for supposing that the standard of honesty is higher among contractors, or any reason for believing that they are less often incompetent? I think not. On the contrary, the long educational training given to the modern engineer makes it distinctly likely that on the average his training is much better than that of the contractors with whom he deals. But as the contractor's financial relation to the job is very different from that of the engineer, he naturally takes every interference very seriously, for interference is usually in the line of demanding higher standards of work at an added cost to the contractor. The average contractor seems to feel that his interest demands that he maintain the lowest standards that the engineer will permit.

So, while the writer believes in doing anything that can be done to clarify specifications and make them entirely fair, and agrees with the editors that the practice of writing specifications which are one-sided should be stopped, at the same time he wishes to point out that even this will not eliminate friction between engineers and contractors, because the real cause of most of the friction lies deeper than the specifications.

Engineers make a great mistake in pretending that an engineer employed by an owner to supervise construction is or can really be an arbitrator between the owner and the contractor. An engineer in such a position is hired to know what the owner wants, and to see that he gets it. If there is friction between the owner and the contractor, either about the nature or the extent of the work, some other engineer or contractor should be called in to arbitrate the matter. The owner's engineer is and ought to be an interested party. Moreover, he ought to know that he is an interested party, and act as an interested party. He would recognize at once the ridiculousness of referring controversies to the contractor's engineer. It is, in reality, equally ridiculous for him to pretend to be able to arbitrate between the owner and contractor.

It is a wonderful thing for a young engineer to have an opportunity to deal with a broadminded, honorable contractor. There are many such. But as long as human nature is human nature, there will always be ignorant, careless and unscrupulous men in the contracting business, and they are not apt to be easy men to do business with. An engineer is the guardian of his employer's rights, and if guarding them requires tact he should use tact, but if guarding them requires a club, he should never be out of reach of at least a couple of them. I believe strongly in writing clear, fair and complete specifications, but engineers should all recognize that no matter how clearly specifications are written, getting them carried out will continue to be a man-sized job.

J. L. HARRISON.
Manila, P. I.

Average Bid as Basis for Award of Contract

SIR: The idea mentioned in the letter of Zenas W. Carter in the Engineering Record of Aug. 19, page 240, that contracts should be let to the bidder nearest the average, appeals to the writer, who has been an advocate of this method for some years past. The writer seriously proposed a number of years ago that when bids are received for any large piece of work the lowest bid and the highest bid should be rejected. The rest of the bids should be averaged and compared with the carefully made estimate of the engineer, which should be submitted in a sealed envelope before the call for bids is issued. The estimate of the engineer should be in the form of a bid, based on day work under his supervision. If the average bid does not exceed the estimate of the engineer by more than 10 per cent, the contract is to be awarded to the bidder closest to, and below, the average, provided his bid is not lower than the estimate of the engineer. Otherwise let the engineer do it.

This method eliminates the low bidders who are ignorant and the men who bid high because they do not want the work, but put in a bid merely to keep themselves in the eye of men having work to do. It is presumed that the only bidders will be those who really want the work and who will figure to get it. Such an arrangement should go far to prevent pooling, for figures cannot be pyramided.

ERNEST MCCULLOUGH,
Consulting Engineer.
Chicago.

New Standard Method for Determining Elastic Limit Proposed by A. S. T. M.

At the recent annual meeting of the American Society for Testing Materials a proposed new method for determining the elastic limit was introduced in the standard specifications for automobile carbon and alloy steels, and sent to letter ballot of the society. Instead of the former simple requirement, "the elastic limit shall be determined by means of an extensometer," the method used by the Pennsylvania Railroad and illustrated by moving pictures at the meeting has been prescribed as follows:

"The elastic limit called for by these specifications shall be determined by an extensometer reading to 0.0002 in. The extensometer shall be attached to the specimen at the gage marks and not to the shoulders of the specimen, nor to any part of the testing machine. When the specimen is in place and the extensometer attached, the testing machine shall be operated so as to increase the load on the specimen at a uniform rate. The observer shall watch the elongation of the specimen as shown by the extensometer and shall note, for this determination, the load at which the rate of elongation shows a sudden increase. The extensometer shall then be removed from the specimen, and the test continued to determine the tensile strength."

HINTS FOR THE CONTRACTOR

Details Which Save Time and Labor on Construction Work

Other articles in this issue of interest to contractors and construction engineers are indexed in the Table of Contents

[Contributions to this section are solicited, and if found available will be paid for. They must be SHORT, *and should be accompanied, if possible, by photographs or sketches.*—EDITOR.]

Forms for Handrail on Large Viaduct Used 66 Times Each

By HAROLD E. KETCHUM

Superintendent Hunkin-Conkey Construction Company, Cleveland, Ohio

SIX SETS of forms are being used sixty-six times each to complete 400 sections of the handrail for the lower deck of the Detroit-Superior bridge in Cleveland, being built by the Hunkin-Conkey Construction Company. Hot tallow for oiling the forms and a small, but powerful, hand winch for pulling the tie bolts and handling the outside form have contributed greatly to the speed and economy of the work.

The handrail is being cast in place between the columns which support the upper deck. Five 1-in. square dowels at each column and seven ½-in. dowels in the curb serve to tie the handrail in place. As the sections vary from 8 ft. to 8 ft. 4½ in. in length, a standard size of form is used, with filler pieces on the outside forms for the longer sections. The inside of the rail is flush with the inside of the columns, and the inside form accommodates both lengths without alteration. To provide a tight joint with the columns on the outside of the rail, where the forms must fit between the posts, strips of light sheet iron are tacked on the edges and at the bottom of the form.

The form for the inside is made of 2 x 8-in. studs sheeted with 1¼-in. ship lap. The outside of the rail has a 2-in. recessed panel, an overhanging molded coping and a wide base. Although it was at first thought necessary to make the form in three pieces, this was avoided by providing a ¼-in. draw on the edges of the panel and the molded coping and by oiling the forms with hot tallow. The ten ½-in. bolts which pass through 2 x 6-in. wales and hold the form together are well greased, and are pulled with a small winch, called the "Pull Lift," the day after the forms are concreted.

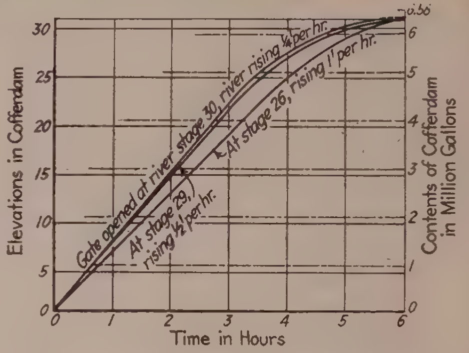
This same winch is used for setting the outside form and removing it, as shown in the photograph. Three men do all the work of setting and moving the forms, a small cart being used to haul them along the bridge. This gang handles the six forms, places the eight ½-in. square reinforcing bars in each panel and helps with the concreting of three complete sections of rail a day. The concreting is done with the regular mixing and cableway equipment used for the east section of the bridge, the concrete being chuted over the edge of the upper deck through flexible pipe spouts. Forty-five minutes is required to fill six rail forms with 7 yd. of concrete. The forms are usually poured in the afternoon and removed the next morning.

The surface of the green concrete is rubbed with a wooden float and a small amount of 1 to 1 mortar until a uniform finish is obtained. A bush hammered surface is required in the recessed panel, and is obtained by scratching the green concrete with a steel brush. One man finishes three sections a day. The long service of the forms is attributed largely to the tallow grease, which is applied hot both inside and outside.

TRUCK AND WATCH-SIZED HOIST AID IN BUILDING BRIDGE RAIL ECONOMICALLY

When to Open the Flood Gate

THE COFFERDAM for lock No. 2 on the Cape Fear River, in North Carolina, described on page 325, was, as usual with river work, expected to be overtopped by extreme floods. Instead of trusting to luck to fill the coffer by opening the flood-gate before water could pour over the top and play havoc with the work inside, the time required to fill the dam through the 24-in. diameter pipe that served as a flooding flume was carefully figured for different stages of the river and different rates of rise. Thus the river stage at which it was necessary to open the floodgate so that the water inside would reach the top at the same time as the river outside was determined. The accompanying diagram shows that with the river rising at a rate of 3 in. per hour it was not necessary to open the gate until stage 30 was reached, as the cofferdam would fill under that head in 6 hours, or by the time the river would reach its top at El. 31. A second curve indicates that with the river rising 6 in. per hour the gate should be opened at stage 29, and the third curve gives 26 ft. as the stage at which the gate should be opened with the river rising 1 ft. per hour. The 24-in. pipe was located at stage 19 on the river gage.



CURVES SHOW WHEN TO START FLOODING

The work on the Cape Fear River is being carried out with government equipment by day labor in general charge of Capt. C. S. Ridley, Corps of Engineers, U. S. Army. Norman M. Chivers, assistant engineer, had direct charge of operations at lock No. 2.

Perforating Ties Before Creosoting Increases Penetration

Perforating Douglas-fir ties in such a way as to take advantage of the fact that creosote oil enters the wood along the grain with greater ease than in any other direction has resulted in a penetration of six times as great as obtained when the tie is not perforated before treatment, according to a bulletin published by the Association of Creosoting Companies of the Pacific Coast. By running the ties through special machines equipped with short metal points mounted on revolving drums, the surfaces are perforated in such a way that it is necessary for the creosote to travel only 3½ in. along the grain from each perforation to treat the wood thoroughly.

The effect the perforating might have on the strength of a tie was determined by tests conducted by the Association of Creosoting Companies of the Pacific Coast, which shows that the compressive strength at the elastic limit of the unperforated creosoted tires was 561 lb. per square inch and that for the perforated treated specimen was 531 lb. per square inch—a decrease in strength of only 30 lb. per square inch.

NEWS OF THE WEEK

Passing Events in the Civil Engineering and Contracting Fields

New England Waterworks Convention Sept. 13-15

Tentative Program Adopted for Three-Day Meeting at Portland, Me.—Addresses by Governor and Admiral Peary

The thirty-fifth annual convention of the New England Waterworks Association will be called to order at 9.30 a. m., Wednesday, Sept. 13, at Portland Me. William F. Sullivan, president of the association, will introduce Oakley C. Curtis, Governor of Maine; W. G. Chapman, Mayor of Portland, and W. L. Blake, president of the board of trustees of the Portland Water District, who will welcome the visitors to Portland. Following the opening ceremonies Rear Admiral R. E. Peary will address the meeting. David E. Moulton will present the only paper now scheduled for the first morning session.

Wednesday afternoon will be devoted to a clambake on Long Island and a steamboat excursion through Casco Bay. In the evening Elbert E. Lochridge will present a paper on the application of coagulant intermittently in excess amounts at Springfield, Mass., and Harvey D. Eaton will discuss the extension of the water-district idea in Maine.

Superintendents' Sessions Thursday

At the morning meeting matters of particular interest to waterworks superintendents will be the subjects of discussion. The materials and methods used in making service connections, leakage from pipe joints and grading cities and towns for insurance purposes are some of the items now scheduled for discussion at that time. An excursion to Sebago Lake, the source of supply of the Portland Water District, and to Poland Springs is planned for Thursday afternoon. The topics at the evening session, at 8 p. m., will be breaks in main pipes and emergency trucks and repair gangs. Friday will be devoted to papers on waterworks accounting and on problems of New Hampshire water supply sanitation. The work of the Public Utilities Commission of Maine will also be outlined. An excursion to Riverton Park will be made in the evening.

The trip to Portland can be made by boat or by rail. Steamers leave Boston Sept. 12 at 7 p. m. A boat leaves New York at 6 p. m., Sept. 11, for Boston, which permits a full day's inspection of the latter city. For those desiring to go straight through from New York to Portland a boat will leave New York at 10.30 a. m., Sept. 11, arriving at Portland Tuesday morning.

Will Place Quebec Bridge Sept. 11

The superstructure for the Quebec bridge will, if weather permits, be floated into position at 5 a. m. Sept. 11. Owing to limited space on the bridge and the necessity of keeping clear that part of the river in which tugs will be operating, no one who is not engaged on the work will be allowed near the span until it is suspended from the links by which it will be hoisted. No steamers or small boats will be permitted to come within certain boundaries while the work is progressing. Space for spectators has been provided close to the bridge on the south shore and on the north shore from about half a mile below the structure to Sillery Cove, where the span has been erected.

Excursions this Friday and Saturday were planned by the St. Lawrence Bridge Company for those who desired a close-up inspection of the structure and the details of the mechanism.

Be Sure to Read It!

Opportunities Offered to American Interests in the Rehabilitation of Europe Are Pointed Out on Pages 310 and 311 by W. S. Kies, Vice-President of the American International Corporation.

Willamette-Pacific Line Completed Last Month

120-Mile Railroad from Central Oregon to Tidewater Opens New Territory — Pay Tribute to Engineer

A three-day celebration was held late last month in the cities of North Bend and Marshfield, on Coos Bay, in southern Oregon, in honor of the completion of the 120-mile railroad between those cities and Eugene. The latter city is on the main line of the Southern Pacific Railroad east of the Coast Range Mountains.

The gathering to witness the dedication included representatives from San Francisco, Portland and other nearby cities. L. J. Simpson, who donated to the city of North Bend, Ore., a magnificent park of virgin timber, in his address paid special tribute to C. R. Broughton, the engineer who built the bridges over the Coos Bay Harbor and the Umpqua River and lost a leg during the construction.

The new railroad has involved some heavy construction in crossing the mountains, including the building of two long bridges. The crossing of the Umpqua River is made on nine 125-ft. spans and one 360-ft. span, while traversing the arm of Coos Bay required nine 150-ft. spans and a 458-ft. drawspan flanked on either side by one 180-ft. span. The Coos Bay bridge with its approaches has a total length of about 1 mile. Both this and the Umpqua River bridges are through Howe trusses. The longest of the nine tunnels on the line is at the summit of the Coast Range. It is 2480 ft. long.

The construction of the road, which is a branch of the Southern Pacific Railroad, has been anticipated for many years and industries have in the meantime developed until the two coast towns are now important ports with a combined population of about 6500. The sawmill at Marshfield is said to be the largest on the Pacific Coast.

Hurricane Sweeps Over West Indies

A hurricane which recently swept over the British West Indian island of Dominica is said to have caused fifty deaths and wrecked a number of bridges and houses. The wind velocity is given as seventy miles per hour and the lowest barometric reading as 29.10.

Concrete Reservoir Collapses

Water released by a 30-ft. break in the concrete reservoir in Madison, Wis., on East Dayton Street, between Blount and Blair Streets, Aug. 26, flooded the new excavation across the street as well as nearly all basements. It is reported that poor concrete, lack of proper reinforcement and the weakening of the wall by excavations for the new reservoir caused the accident.

The nearness of the new excavation into which most of the water rushed is said to have prevented the flood reaching the city barns and other nearby structures. The reservoir was erected about ten years ago.

Outline Water Policy for Pennsylvania Commission

Report Urges Co-operation in Planning Projects—Cost of State-Wide Survey Estimated at $800,000

Plans to provide for more perfect co-operation between the state and different communities or corporations considering flood-control or water-supply construction in Pennsylvania are included in a report submitted by the Pennsylvania State Water Supply Commission made public this week. The report also recommends the enlargement of the present water code so that methods will be provided for legal co-operation in constructing and maintaining water-control works.

It is pointed out that a condition is being reached where, unless the water sources are controlled and conserved, those sources will not be sufficient to serve the needs of the state and a gradual slackening of development will occur. Also, states the report, there is every indication that an increase in the use of water will continue indefinitely and at an accelerating rate.

Must Have Knowledge of Streams

An adequate policy for the control and regulation of the waters of the state, according to the document, cannot be formulated until a thorough knowledge is obtained of the streams of the state nor until general plans are prepared for solving those problems. An orderly legal code, which will make practicable the execution of plans and will insure control and supervision over construction affecting the river system, is recommended.

The Water Supply Commission, says the report, should be a clearing house of general information on problems of public water control—not in the sense of being consulting engineers, but in outlining policies and furnishing information which only a public institution can collect. As water-control projects are initiated from time to time in various parts of the state, the commission should furnish advice as to the general methods which may be used in approaching the problems, and, subject to final review by the Public Service Commission, should have regulatory powers over such undertakings. This advice and direction should indicate whether the community or corporation can best work out its problems alone or in co-operation with other communities and whether a single object such as water supply can best be secured alone, or whether more than one object, such as water supply and flood prevention, or water supply and power development should be provided for by the same improvement.

Emphasize Need for Inspection

The question of the safety of structures is also discussed and the importance of proper examination emphasized by pointing out that a single dam failure may cause damage of an amount sufficient to cover the inspection cost for several years.

The necessity is emphasized for a water code giving the commission power to adjust the costs so that co-operation may be secured between communities affected by a development. The creation of a court of appeals is suggested as a possible measure to afford a means of settling differences of opinion between the commission and corporations and municipalities. The cost to cover the entire State of Pennsylvania, developing the possibilities for flood control, water supply and water power on each river system in the state is estimated at $800,000. The time to complete a state-wide survey is given as about five years.

Washington Commissioners and Engineers Meet at Tacoma

The joint convention of the Washington State Association of County Commissioners at Tacoma will be opened in the Hotel Tacoma Thursday morning, Sept. 14. After the address of welcome by Governor Lister the two associations will adjourn to their respective halls. Both programs include many papers on road and bridge construction. G. M. Savage, president of the Washington Paving Company, will speak from the contractors' viewpoint.

A joint session will be held Friday morning, after which each body will follow its own program until Saturday evening, when a joint banquet will be held. Sunday will be devoted to an automobile tour of Reese's Camp.

May Revive Mississippi River Traffic

The St. Paul Association of Commerce has appointed a special committee on river traffic which will attempt to work out a comprehensive plan for the development of adequate river terminals. The chairman, J. W. Cooper, has called to his assistance a citizens' "Committee of One Hundred," in the membership of which are included nine civil engineers, who will constitute a subcommittee.

200-Foot Slide Reported on Panama Canal Last Week

A slide on the Panama Canal was reported last week to the Panama Canal Commission at Washington. Despatches stated that about 200 ft. of the channel was blocked. No news of the reopening of the canal has yet been received.

Will Build Canal in Uruguay

The Congress of Uruguay has decreed that plans shall be made for dredging and making into a canal the Miguelete River, which runs through Montevideo and empties into the bay. The decree states that in addition to the work in the stream, an avenue, necessitating much bridge construction, is to be built on each bank.

Will Investigate Need for Improvement of Quequechan River

The nuisances in and along the Quequechan River in Massachusetts and upon the lands adjacent thereto and the necessity for the construction of drains and sewers for the disposal of sewage will be investigated by a commission just appointed. A suitable method for the control and protection of the waters of the river and plans for its improvement will be suggested later. The report must be presented on or before April 1, 1917, to the city council of Fall River, Mass.

Joseph Turner, of Fall River, is chairman and H. K. Barrows, consulting engineer, of Boston, is consulting engineer for the commission.

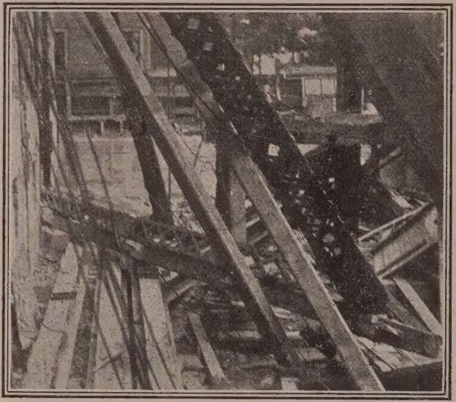
Town and County Roads Subject of Convention at Syracuse Next Week

The meeting of the New York State Association of County Highway Superintendents will be opened by the president, James F. Loughran, Sept. 13 at Syracuse. Discussion of the office of town superintendent, uniform prices of machinery, the use of automobile license fees in county or town highway work and the county as a unit in highway administration will comprise the work of the first day. County road construction and maintenance and a paper on the class of road or pavement best suited to towns and counties are included in Thursday's program. The advisability of increasing the carrying capacity of new steel and concrete bridges will also be considered.

Many Lives Endangered When Boom Buckles Under Load

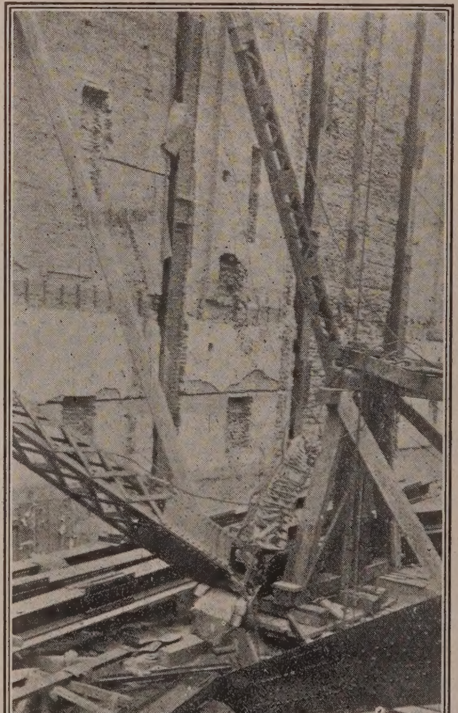
Seven-Ton Load Causes Failure During Erection of Steel Building in Erie, Pa.—Nobody Injured

Although many lives were endangered on Sept. 1 by the buckling of a steel boom during the erection of the Ariel Building, at the corner of Eighth and State Streets, in Erie, Pa., no person was injured. The 7-ton column section which caused the failure balanced vertically on end before it toppled over toward State Street and fell directly across the construction shanty, crushing it.



BOOM BUCKLED AT END OF TIMBER BRACE

The steel boom had been reinforced near the center by a piece of 8 x 10-in. timber 20 ft. long, lashed to the boom. While raising one of the front columns weighing about 7 tons the boom buckled at the ends of this timber brace and allowed the column section, which was about 64 ft. long, to drop vertically into the cellar of the building. The warning cries of those who saw the failure made it possible for pedestrians and workers to escape. The boom and its supporting frame struck the wall of the Arcade Building, but caused no damage to wall or building, as indicated in the photographs.



CRANE FRAME FELL AGAINST WALL

It is reported that hereafter cranes will be inspected by the commissioner of public safety of the city. The erection is being done by the Erie Steel Construction Company.

Ohio County Will Not Use Macadam

The Board of Hamilton County commissioners, Cincinnati, Ohio, decided at its meeting Aug. 29 not to use macadam for any more permanent road improvements. Following a conference the announcement was made that all future improvements on county roads will be either of concrete or brick. Hamilton County has been spending about $700,000 a year on the construction of macadam roads.

Will Consider Applications for Contract on Bridge or Tunnel

At the last session of the Louisiana Legislature a joint resolution proposing a constitutional amendment to authorize the construction of tunnels or a bridge to connect the east and west shores of the Mississippi River at or near New Orleans was adopted. The amendment will be voted on at the general election Nov. 7, when it is expected the measure will be passed with a large majority.

The Public Belt Railroad Commission of New Orleans has appointed a special committee to study the situation. The committee has heard discussions of the project by a few prominent engineers, but desires to hear from all engineering firms that may wish to submit applications for contract in connection with the work. F. H. Joubert, secretary and general manager of the Public Belt Railroad of New Orleans, will furnish further information.

Organize to Secure Nitrate Plant on Ouachita River, Arkansas

A meeting was held Aug. 31 in Arkadelphia, Ark., at which representatives of ten cities organized for the purpose of having a government nitrate plant erected on the Ouachita River near Hot Springs. It was claimed that a dam could be built "with a crest elevation as great as 750 ft. and a reservoir capacity of 400,000,000,000 cu. ft. without flowing through any gaps." All of the land that would be inundated is said to be owned by the government.

The next meeting will be held at Hot Springs, at which Major Harold C. Fiske will be the chief guest.

Boise & Arrowrock Railroad for Sale

The sale of the Boise & Arrowrock Railroad, which was built and operated by the U. S. Reclamation Service to carry material to the site of the Arrowrock dam, was authorized by Congress last month. The right-of-way and such equipment as it may be deemed advisable to sell will be disposed of by the Secretary of the Interior. The value of the road will be appraised by three disinterested persons and the property disposed of at public auction at a price not lower than the amount named by the committee of three.

Panama Official Weekly Changes Size and Name

Beginning with the issue of Aug. 23, the *Canal Record*, the official weekly publication of the Panama Canal, became the *Panama Canal Record*, and its page was reduced in size to 6 x 9¼ in., conforming to the prevailing form for pamphlets of other government publications. The new form begins Vol. X. The original form of the *Canal Record*, which was adhered to throughout nine years of canal work, beginning with the publication of the first number Sept. 4, 1907, was derived in general from the make-up of a bulletin published by the first French company.

What Engineers and Contractors Are Doing

JOSEPH H. NUELLE, formerly assistant general superintendent and chief engineer of the New York, Ontario & Western Railway, has been promoted to the position of general superintendent. He will continue to make his headquarters at Middletown, N. Y. After graduation from Princeton University in 1906 Mr. Nuelle joined the engineering forces of the Pennsylvania Railroad as transitman. He resigned early in 1907 to take a similar position with the New York Central and Hudson River Railroad, which he left in June of the same year to become assistant engineer of the New York, Ontario & Western. Promotion to the grade of principal assistant engineer came in 1911 and to that of chief engineer soon after. In 1915 he was made assistant general superintendent in addition to his duties as chief engineer.

EDMUND GELWIX has resigned as assistant engineer for the St. Louis-San Francisco Railway to become valuation engineer for the Kansas City, Clinton & Springfield Railway, with office at Springfield, Mo.

ROSS MILLER has been appointed engineer of the South Dakota Railroad Commission to succeed J. E. Love, resigned.

W. C. NIXON has been elected president of the recently incorporated St. Louis-San Francisco Railway, which succeeds the St. Louis & San Francisco Railroad. Since July, 1913, he has been chief operating officer and receiver of the old St. Louis & San Francisco.

C. N. YARGER, superintendent for J. L. Richmond, general contractor, of Richfield Springs, N. Y., having completed the work of reconstructing highways and bridges adjacent to the Hinckley reservoir barge canal water supply, has moved to Richfield Springs. From that point he will direct the building of eight miles of state highway in Otsego County, for which his company recently secured the contract.

WENDELL M. JONES, a recent graduate of the engineering department of the University of California, is now assistant hydrographer for the U. S. Reclamation Service. He is located at Spanish Fork, Utah, and employed on the Strawberry Valley project.

A. C. LYON, expert chemist, has been placed in charge of the laboratories of the recently organized General Testing Laboratory, Kansas City, Mo. Mr. Lyon was for ten years chief chemist and vice-president of the Kansas City Testing Laboratory Company, previous to which he was employed by the Carnegie Steel Company. He also at one time taught chemistry at the University of Missouri. He will direct tests and analyses of asphalts, cement, metals and alloys as well as conduct general physical tests.

E. L. BROWN, formerly vice-president and general manager of the Denver & Rio Grande Railway, has been elected president of the Minneapolis & St. Louis Railroad, succeeding Newman Erb, resigned.

GEORGE C. WHIPPLE, professor of sanitary engineering at Harvard University and member of the consulting engineering firm of Hazen & Whipple, New York City, has been appointed a member of the commission to investigate the proposed garbage-reduction plant for Staten Island. The residents of Richmond Borough claim that the plant would become a menace to the public health. Mr. Whipple has studied water-supply and sewage-disposal problems in a number of large cities in the United States and served as a member of the faculty of the Brooklyn (N. Y.) Polytechnic Institute for several years. He was graduated from the Massachusetts Institute of Technology in 1889 and immediately thereafter engaged in water-supply engineering. After fifteen years of laboratory work in Boston and New York he became associated with Allen Hazen in the firm of Hazen & Whipple. He was appointed to the Harvard faculty in 1911.

LOUIS K. ROURKE, of Rourke & Sherman, consulting engineers, of Boston, has been retained by the Braden Copper Company to investigate and report on its railroad at Braden, Chile. Mr. Rourke will sail almost immediately and be gone for about five months. Mr. Rourke is a graduate of the Massachusetts Institute of Technology, class of 1895. His first engineering work was with the Boston & Maine Railroad, whose employ he left in 1897 to become supervisor of track for the Panama Railroad. During the next five years he was engaged on railroad work in Ecuador, following which he spent about two years in Mexico. In 1903 he was made superintendent of construction of the Guayaquil & Quito Railway, but returned to Massachusetts the following year to engage in highway construction contracting. Again he went to Panama in 1905 to join the Isthmian Canal Commission, returning to the United States in 1910 to become superintendent of streets for Boston. He resigned last year to join Edward C. Sherman in the consulting firm of Rourke & Sherman.

FRANK H. OLMSTEAD, of the consulting engineering firm of Olmstead & Gillelen, Los Angeles, Cal., has been named by Franklin K. Lane, Secretary of the Interior, as the engineer to design flood-protection plans for the Gila River.

D. K. CALDWELL, who has for the last year and a half had charge of the expenditure of a bond issue in Gregg County, Tex., was recently appointed engineer of Caddo parish, Shreveport, La. The parish expects to spend about $1,000,000 on road construction during the next few years. Mr. Caldwell was graduated from the Alabama Polytechnic Institute in 1908 and was then made assistant county engineer of Montgomery County, Alabama. A year later he was appointed assistant city engineer of Montgomery, resigning in 1911 to become county engineer for Covington County. Upon the completion of that county's road system Mr. Caldwell went to Elmore County in a similar position, from which he resigned to become assistant to the parish engineer at Shreveport, La. He left Shreveport to go to Gregg County, Texas, early in 1915.

C. B. CARVER has resigned as junior engineer for the New York Conservation Commission to enter the engineering department of the New York Central Railroad, with office in New York City. Since his graduation from Bucknell University in 1914 Mr. Carver has been employed by the commission on water-power, drainage and storage work.

E. A. KEMMLER, formerly department engineer on the new Akron (Ohio) waterworks, is now chief engineer of the Coventry Land & Improvement Company of that city. The company is developing a large tract in the south part of Akron in which model sewers, streets and houses will be constructed as rapidly as possible. The enterprise, which will involve millions of dollars, is not being run for profit. Mr. Kemmler was graduated from the Ohio State University in 1888. He was assistant professor of civil engineering at his alma mater from 1891 to 1896, resigning to become city engineer for Columbus, Ohio. He engaged in engineering work in Oklahoma in 1910, but returned to Ohio the next year to become department engineer of the Akron waterworks.

F. T. CROWE has been promoted from construction engineer for the U. S. Reclamation Service to the managership of the Flathead project, with headquarters at St. Ignatius, Mont. Mr. Crowe was graduated from the University of Maine in 1905 and immediately entered the employ of the reclamation service as chief of party. For two years he was employed on irrigation and canal work, resigning in 1906 to become engineer for James Munn & Company, contractors, of Deadwood, S. D. He again joined the reclamation service in 1908 and in 1911 was made assistant superintendent of construction on the Arrowrock dam. In 1913 he was transferred to the Boise, Idaho, and later to the Jackson Lake projects as construction engineer.

LINCOLN BUSH, consulting engineer, of New York City, has been chosen the third member of the arbitration board to settle the controversy regarding the rehabilitation of the Galveston causeway. As stated in this journal in the issue of Aug. 5, page 185, Professors A. N. Talbot and George F. Swain were the appointees respectively of the steam railroads and the county and electric railway, and these two have now selected Mr. Bush to officiate with them.

R. N. BEGIEN, chief engineer of the Baltimore & Ohio Railroad, has been appointed a member of the engineering committee of the Presidents' Conference Committee, the railroad organization formed to uphold the railroads' interests in the federal valuation of the carriers. Mr. Begien succeeds F. L. Stuart, resigned.

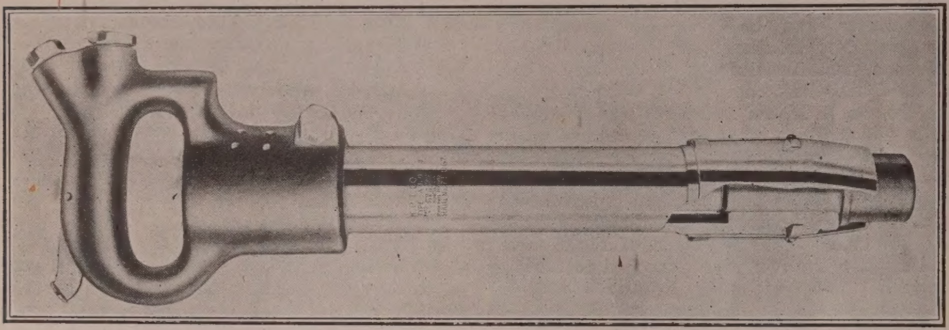
GUSTAV ADOLPH MATHIAS LILJENCRANZ, U. S. assistant engineer at Chicago since 1871, was recently given a dinner at the Chicago Engineers' Club on the occasion of his departure for Sweden, the land of his birth, as noted in these columns last week. He was born in 1842 and obtained the degree of civil engineer from the Royal Technological Institute, Stockholm, in 1866. For two years thereafter he was engaged on the construction of the Dahlsland Canal, Sweden. He entered the employ of the U. S. engineer office at Milwaukee in 1869, leaving the government service the next year to go to the Chicago, Milwaukee & St. Paul Railway. In 1871 he returned to the government service and was stationed at the Chicago office, where he has been since employed. Mr. Liljencranz has been a member of the Swedish Technological Society since 1866.

Obituary Notes

JESSE SUPPLEE, civil engineer, of Erie, Pa., died recently at his home in that city at the age of 74. Mr. Supplee retired from active service about two years ago after nearly fifty years in engineering work. He was born in 1844 at Gwyneed, Pa., and first took up engineering in 1866 as draftsman and transitman on branches of the Philadelphia & Reading and the Columbia, East Pennsylvania & Perkiomen Valley railroads. The following year he was made assistant engineer in charge of surveys and construction of Fairmount Park, Philadelphia, retaining that position until 1872, when he went to the Pennsylvania Railroad. For seven years he was assistant engineer in charge of new work, tracks, buildings and bridges on the Pittsburgh division of that road and also directed the grading for and construction of four tracks through Pittsburgh. From 1879 to 1881 he was supervisor of the Bald Eagle Valley Railroad and assistant engineer on the Tyrone division of the Pennsylvania. In the latter year he took a position as assistant engineer for the Philadelphia & Erie Railroad, in which capacity he had charge of maintenance of way and building of all new works, tracks, building and bridges. He and his son formed the engineering firm known as the Supplee Engineering Company in 1900 and Mr. Supplee, senior, became chief engineer of the Pennsylvania & Ohio Bridge Company. The firm, among other things, had charge of all engineering on an electric line from Erie to Albion, Pa., and Conneaut, Ohio. Mr. Supplee retired from active practice about two years ago and the firm was dissolved.

Device Prevents Dropping or Shooting Out of Rivets

A new attachment for pneumatic hammers, which is claimed to eliminate accidents caused by dropping or shooting out of rivet sets or chisels and pistons, is being manufactured by the Keller Pneumatic Tool Company, Fond du Lac, Wis. The device, it is said, will hold any rivet set in place even though the air be turned on when the instrument is held in the hand.

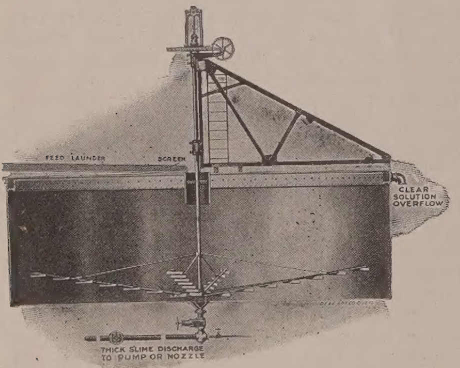

POSITION OF ATTACHMENT WHEN CATCH AND SPRING ARE RAISED

The two retainers are raised by a slight turn of the metal casing to which they are attached, thus sliding them out of the slots into the smooth surface of the tool. The spring is sufficiently strong to hold the flat surface of the retainers in the slots and keep the device in place. The safety retainer can be attached by hand to any make of hammer.

Metallurgical Thickener Applied to Sewage Purification

Engineers interested in sewage disposal have recently been searching other industries for apparatus and methods that may help them to solve their problems. Some have investigated the metallurgical field, where many problems similar to theirs have been successfully met, and where there is a growing tendency to use continuous methods.

One problem which for many years gave the metallurgist a great deal of trouble was the treatment of the large volume of slime always produced in crushing ores. "Slime" is the name usually given to that portion of the ground material which will pass a 200-mesh screen. The Dorr continuous thickener, invented by J. V. N. Dorr, was developed to handle that slime. It is now being introduced for sludge settling.



THICKENER PERMITS BUILDING EXTREMELY SHALLOW SEDIMENTATION BASINS

The apparatus consists of a central-vertical shaft carrying radial arms equipped with plows set at such an angle that the slow rotation of the arms brings the thickened material to the center. At that point it is discharged, thus allowing the settling operation to be continuous. The slow motion of the arms is obtained by means of a worm gear. The illustration shows a standard machine.

The liquor to be settled is delivered near the center of the basin in a suitable well, with a float to cause minimum disturbance. The overflow is taken off by a peripheral overflow channel. The bottom is built so as to conform to the slope of the arms. The plow blades are provided with rubber scrapers so that the bottom is always kept clean.

The arms revolve at a very slow speed. For thin sludges one revolution in from 45 minutes to one hour is recommended. The power required to operate the mechanism would not exceed 1 hp. for a thickener 90 ft. in diameter. The thickener is built for basins up to 200 ft. in diameter. The slope required for the bottom is only 1¾ in. to the foot, which permits large sedimentation basins equipped with Dorr thickeners to be built with unusually shallow depths. This greatly reduces the original cost of construction, compared to hopper or conical bottom basins, particularly as most sewage sludges require a slope of more than 45 deg. to prevent building up of solids.

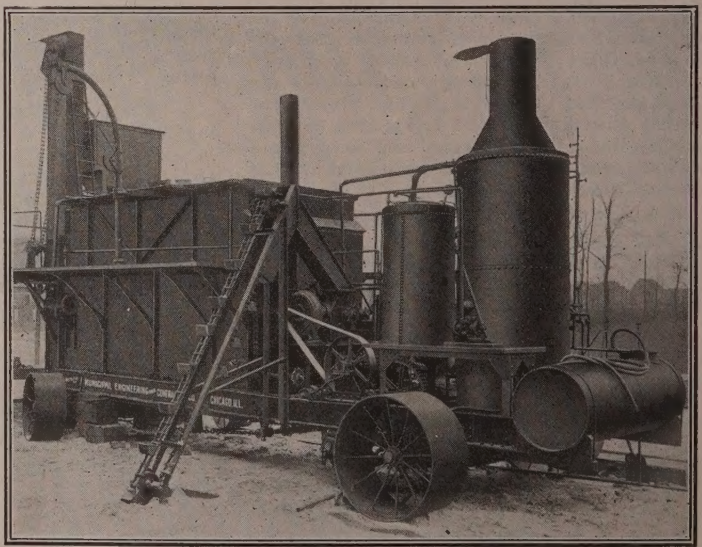
As noted in the issue of Aug. 5, the Dorr company has established a sewage-disposal department under the direction of H. W. Morgan, formerly with the Milwaukee Sewerage Commission.

Nesting Drum Makes Portable Asphalt Mixer Compact

Compactness so as to make the whole outfit portable has been obtained in a new ½-yd. asphalt mixer recently put on the market. The large car plants average about 1800 sq. yd. of 2-in. pavement per day of 8 hours, while this one has a capacity of 1200 sq. yd.

The drier consists of three drums built into one unit, the largest of which is 68 in. in diameter. They occupy a space 14 ft. long, while the equivalent continuous single drum would be 4 ft. 3 in. in diameter and 40 ft. 8 in. long. As the speed is 8 r.p.m., and it takes 4 minutes for the material to travel the length of the drier there is an effective area of 17,376 sq. ft., permitting, it is claimed, a low fuel consumption and a high heating temperature.

HOT PORTABLE MIXER HAS THREE-DRUM DRIER NESTED FOR COMPACTNESS. OUTFIT WEIGHS 26 TONS AND TRAVELS UNDER ITS OWN POWER. CLAIMED TO HAVE LOW FUEL CONSUMPTION AND HIGH HEATING TEMPERATURE.



The melting pot is located above the drier, so does not need a separate fire. Additional heat comes from exhaust steam in coils run through the kettle. It has two compartments and can be equipped with a fluxing tank for a half day's run. The measuring boxes of one-half batch capacity are equipped with a standard scale beam. The material is screened to proper size before entering the measuring box.

The mixer is of two-spindle, pug type. It discharges directly into wagons which can be driven under the spout without excavation of the ground. The length over all is 34 ft. 9 in.; height, 18 ft. 9 in., and width, 7 ft. 3 in. The outfit weighs 26 tons and travels under its own power at 1 mile per hour. It is manufactured by the Municipal Engineering & Contracting Company, Chicago.

Business Notes

The Chicago Bridge & Iron Works recently opened an office in the Florida Life Building, Jacksonville, Fla., in charge of Elwood G. Ladd, who will handle the company's business in Georgia, Florida and Alabama.

Adolph G. Carlson, formerly assistant superintendent of the Syracuse, Ind., plant of the Sandusky Portland Cement Company, has been made chief engineer of the Universal Portland Cement Company.

A. C. Wilby, who has been in the sales department of the Universal Portland Cement Company for about seven years, has been made assistant to the president.

The Chicago Chapter of the American Association of Engineers held its regular meeting Aug. 18. The meeting was well attended by members and guests, many of whom participated in the discussions of topics of importance to engineers.

The Camp-Te Roller Agency, Seattle, engaged for the last thirteen years in the sale of building materials, has dissolved. H. Te Roller will continue to handle the accounts carried by the agency, with office in the Globe Building, while E. H. Camp will confine himself to metal and hardwood interior finishing materials, and will be located at 515 Bell Street.

W. A. Lamont, for twenty-one years connected with the Pacific Hardware & Steel Company in Portland and San Francisco, recently opened an office in the Colman Building, Seattle, and will represent the Rolph Mills Company, of San Francisco, which handles the L. A. Norris products on the Pacific Coast; the Sneath Glass Company, manufacturer of sidewalk lights, and the McClintic-Marshall Company. A complete stock will be carried in Seattle.